Australian Model Engineering

March-April 1996

Issue 65

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In This Issue:
- ☑ South African Steam in South Australia
- ☑ Inverell Turns It On For Traction Engines
- ☑ Task Force 72 Sails Into History

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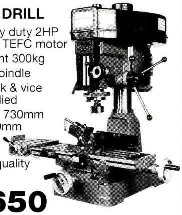

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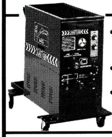

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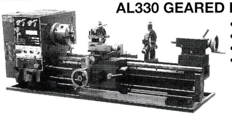

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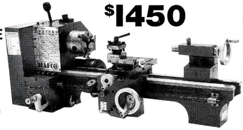

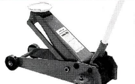

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Friday 15 March 1996

March-April 1996 Issue 65

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The Cover

South Africa's glamour and John Wakefield's pride awaits a turn of duty at its home depot. The feature story starts on page 9.

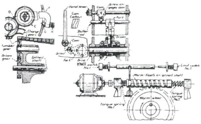
Photo by John Lyas

Handbook of Practical 1942 Illustrated How-to

Mechanical Design

by Nordenholt, Kerr & Sasso
reprinted by Lindsay Publications Inc.

Designing machines can be a lot of fun, and there a lot of books that will teach us a theoretical approach. And there are other books that teach far-out high-tech design. But how many of us need to design a payload adapter ring for an Atlas-Agena rocket? A simple clamping bolt or a simple labyrinth shaft seal is more my speed, and a great deal more useful.



This gem of a practical design handbook appeared in 1942, and was essentially a reprint of practical design articles from Product Engineering magazine. You get practical design ideas, variations, bits and pieces, hints and tips, basic formulas, and even electrical information for getting the job done. The theory you get is practical and straight to the point.

Chapters include charts and tables; materials; beams and structures; latches, locks and fastenings; springs; power transmission elements and mechanisms; drives and controls; and design data on production methods.

You get charts and nomographs for calculating useful things like finding the length of material needed for 90 deg. bends (such as electrical conduit). Or volumes (in gallons) of horizontal round tanks with flat ends. Or for calculating the weight of a certain number cubic inches of brass (or vice versa). And much, much more.

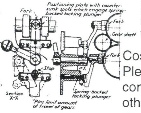
You get data on alloys from simple old gray iron to stainless. Although I'm sure some of this is dated, it's not totally useless. You get a detailed chart of "Characteristics and Use of Wrought Brasses and Bronzes". You get another chart on the plastics of that day. And much more.

You can calculate stress on aluminium sheets, compression members, shear members, diagonal tension webs, hollow girders, stresses in cantilever beams, and more.

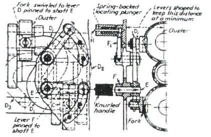
Then you get a picture section illustrating various ideas and variations for locking devices, retaining and locking detents, taper-pin applications, hinges and pivots, clamping shoes and plugs, lock bolts, machine clamps, door and cover fastenings and more.

You'll learn about various types of springs, their natural frequency, design calculations, standard drawings, graphs to simplify calculations and more.

The power transmission section will help you with simple calculations to size components in your transmission set up. You also get page after page of fascinating drawings illustrating couplings, clutches, gibs and guides, bearings, change gears, automatic feed hoppers and more.


Fork
Positioning plate with countersunk spots which engage spring-backed locking plunger
Fork
Gear shaft
Fork
Stop
X
Section X-X
Spring-backed locking plunger
Pins limit amount of travel of gears

The chapter on drives and controls will be quite informative to anyone who lacks electrical knowledge (most of us). Here you explore types of motors and their characteristics from starting to running under full power. You explore various types of three phase motor windings, simple rectifier circuits for changing AC to DC, and control equipment (most of which I'm sure has been replaced by new technology), and more.


Fork swiveled to lever D pinned to shaft E
Cluster
Spring-backed locating plunger
Levers shaped to keep this distance at a minimum
Cluster
D₁
H
F₁
D₂
F
E
E
D₃
D₁
Knurled handle
Lever F pinned to shaft E
Fork

The last chapter covers production methods for fusion welding, resistance welding, furnace brazing, flame hardening, centrifugal casting, permanent mold casting, die casting, forging, flame cutting and powered metal pressings.

I think you'll find something useful here no matter what kind of machine you want to build whether it's a lathe or tool post grinder or that replica B-17 you want to build to bomb your mother-in-law. Even if you don't build anything, the "pitchers" are "purdy", and you're sure to learn something no matter what page you open the book to. In other words, this is a fun book to browse through. Get one! 8½ x 11 paperback 277 pages

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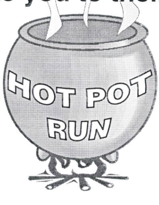

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at
the
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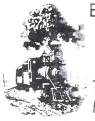

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Comment

Model Engineering — a way of life

"Model Engineering — an Enjoyable Hobby" — Part two

As the cliché runs, "Anything is what you make it", and so too is model engineering. Personally, my life has grown and developed because of the hobby — its become part of me: an inseparable part!

Never is there and evening, day or weekend when I don't have something enjoyable to look forward to. Every 'job' is a new challenge. For me the enjoyment is the creativity; the production of things that work is the key. But it's not an instantaneous hobby. A football match lasts eighty minutes but does not provide long-term satisfaction that can match the wonderful feeling of creating a working machine that you have made yourself. The gradual process where the building is more of the pleasure than the finished result is something non-model engineers find difficult to comprehend. To me the time is well spent, if in the finish (years away), I have produced a living, breathing machine, viz a steam locomotive. Yes it can be done; if you feel any self-doubts on occasion, read an LBSC *Model Engineer* article from the 1940s or 50s for reassurance. He was a vital, positive leader in the growth of the hobby who stressed enjoyment. His emphasis was that success would be obtained, to use his oft repeated phase, "with average care".

Acquaintances at work marvel at the patience required to construct a steam locomotive. However, I couldn't be content spending my evenings watching television or filling in time. If there is half an hour to spare I will be in the workshop. My wife always knows where to find me! How do people spend so much time glued to the television or frying on a beach? I wouldn't swap my workshop. Where I work I have placed a sign on the wall: five minutes wasted can never be regained. Model engineering has always given me incentive to utilise time effectively.

I do feel fortunate that I was introduced to the hobby at a young age and was in a position to 'get started' in my late twenties. But if you are reading this, wanting to get started and are any other age, don't hesitate anymore, because it is never too early or too late. With this hobby the world is your oyster — you're the boss and this is a marvellous feeling. You can enjoy the fellowship with kindred souls or work as a lone hand....

To borrow one of those overworked phrases so beloved by politicians, it's "the big picture" that makes it so rewarding. There is something for everyone. Some years ago when my employment was less than pleasurable, the workshop was a safety valve, a place that would bring me back to normal. So, it's over to you now. If it is half as rewarding for you as it is for me you will never have any regrets-happy times and happy steaming.

Hugh Elsol

This is an open invitation, during 1996, for all model engineers to tell us how you find "Model Engineering — an Enjoyable Hobby". Thanks to those who have already sent in material... bmc.

To our new reader

If this is your first issue of Australian Model Engineering, welcome! We hope you'll look forward to the ideas, news and camaraderie in each bi-monthly issue.

One of the great things about our hobby is the way model engineers actively help each other. Unless you live in an isolated community, you'll soon discover who has valuable experience in your field of interest, or who will help you to make a part that's too big for your workshop machinery. Look in the *Club Roundup* section to find a club that's near to you; pay a visit and you'll usually find model engineers who live not too far away. Then you can experience the great fellowship that makes our hobby special.

This magazine is prepared in the same spirit of "model engineers helping each other". About two dozen people put many hundreds of hours work into each issue — all on a voluntary basis — to help model engineers in Australia and New Zealand keep up to date and stay in touch.

We rely on our readers to write articles for us — for the same (non-existent) rate of pay! If you have ideas or techniques that you feel would be interesting to others, please drop us a line. We'll gladly help with preparation of artwork or editing if that's necessary. Most important of all, please support the people who advertise in our magazine. Without them to pay the bills, you wouldn't be reading this!

Brian Carter

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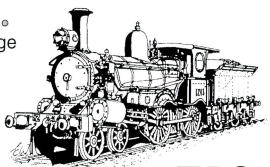

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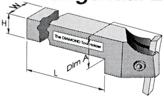

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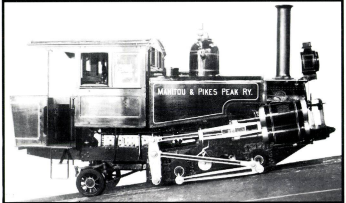

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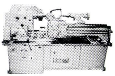

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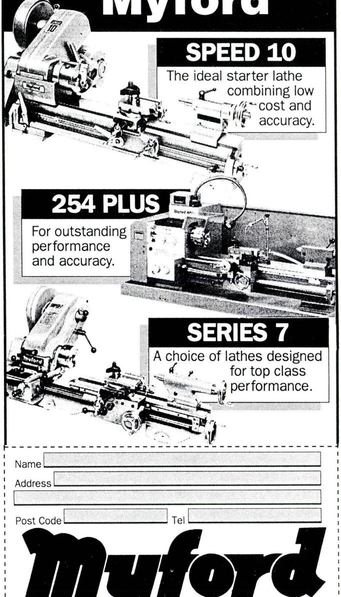

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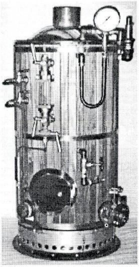

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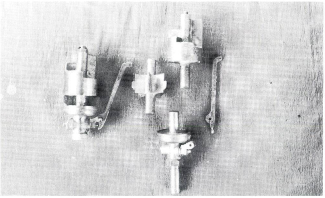

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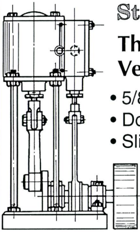

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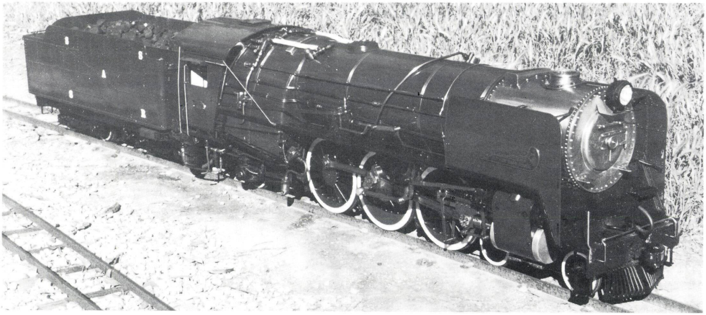


South African Steam in South Australia

Class 16F, the big 4-6-2 from the other SAR

by John Wakefield

Photos supplied by John Wakefield and John Lyas. Publication drawings by Peter Manning, Ray Lee and Neil Graham

With my 5" gauge *Caribou* — a sturdy 2-8-0, normally called *Buffalo* — completed and on the road, things settled down, until I received a call-from-the-wild!

The desire to build another locomotive swelled as a result of two visits to South Africa. The first in 1973 and again in 1976. Steam power was still operating which, at the time, numbered about 1800 locomotives!

South African steam safari

For a period prior to 1973 I corresponded with prominent model engineer, Rene Etter and his good wife Evette, who incidentally also built a 3½" gauge *Caribou*, with a little help. My course was being set for a wonderful nine weeks tour of the country, including visiting many model engineering clubs. With Rene's help I was able to contact many model engineers, eventually ending up in Cape Town. This was not before a stopover in Bloemfontein, where I saw the first 16E, No.857, being prepared to be placed on a plinth in front of the main station. And while passing through De Aar, a major junction in the middle of the Great Karoo, I saw No.858, the other of the two still existing of the original six.

By this time the big South African engines, and I mean big, every bit as big as our engines of the 5'3" gauge, South Australian Railways, were holding me in awe.

Sowing the seed

But it wasn't until Cape Town that I saw — and which really astounded me — just how big one of these locomotives would be in 5" gauge (scaled at 1½" to the foot). Dick Marshall-Smith, a model engineer in Bloemfontein, gave me the address of a fellow model engineer in Cape Town, Bill Schultz. Bill had his own garden railway and a 5" gauge class 16DA 4-6-2 — a fore-runner of the 16E — which I just had to see. The sheer size of this engine in 5"g completely dumbfounded me, and from that time on after seeing the big 16E, with 6ft driving wheels and smoke deflectors which the 16DA's didn't have — I think that smoke deflectors give a locomotive character — I was sold.

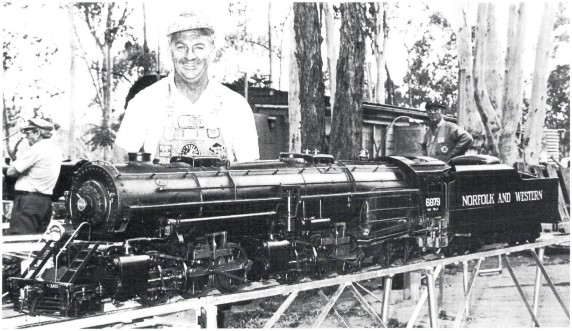
From there as the saying goes, the wheels really started to turn (excuse the pun) and on returning to Johannesburg I discovered that the railway drawing office was 60 miles north at Pretoria, I made arrangements to get a general arrangement (GA) drawing to go on with.

The seed takes root

On my return in 1976, with my mind completely made up about what I was going to build, I went to the main administration building in Pretoria and received a great deal of assistance from the chief draughtsman. I eventually came away with ninety six sheets from which I built the locomotive in its present form.

In addition to the drawings I also returned from that second trip with wheel patterns kindly loaned from Rene Etter. Basil Palmer, of Johhanesburg, also used these patterns for his 16E Gold Medal winner of the 58th *Model Engineer* Exhibition in London (1988/9). I had them cast in Adelaide and returned them to Rene, to whom I am sincerely

One of the authors early efforts, a 5" gauge Canadian National Railways 2-8-0 ***Caribou****, seen here at the AMSRS Railway Park on passenger hauling duties in 1978.*



The Big A
The author's 5" version of the Norfolk and Western's Class A 2-6-6-4, a.k.a. ***Big Fella****, at the QSMEE Pine Valley Railway in Brisbane, Easter 1992. Since this photo was taken, further small detail changes have occured to bring the loco in line with the N&W prototype including re-numbering..*

grateful. These castings gave me a good start. The frames were then oxy-cut, the front bogie frames completed, the tender underframes started, and then things started to slow down.

A big diversion

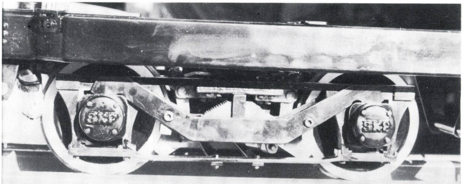
A string of events kept me from the 16E for many years. In late 1976 I bought, as a complete wreck, a 5" gauge 2-6-6-4 Norfolk and Western A Class articulated locomotive. After re-designing and re-building it twice, the second time providing it with a new copper boiler, while at the same time building the boiler for the 16E. I bought a State Transport Authority bus in 1983, spending three years converting it to a motor home. I then retired from my plumbing business and spent eight months of 1986 touring the west, the north west, the north and the north central of Australia. Following the convention in Melbourne in 1988 I toured the east coast for nine months and in that time run *Caribou* on seventeen different tracks. Following the Brisbane convention in 1990, this time with a 4WD and a caravan, went further up the east coast, again with *Caribou* and more tracks to run on. Travelling as far north as Cairns, the Daintree, Cape Tribulation and Cooktown.

Back to the 16E

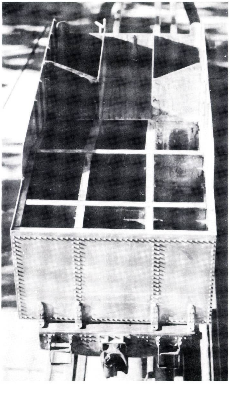
The travel bug was now well and truly out of my system and thoughts returned to completing the 16E. I always consider the tender to be the first priority when building a locomotive, it has to be built anyway, and when the engine is finished it is just a matter of coupling the two together.

The Tender

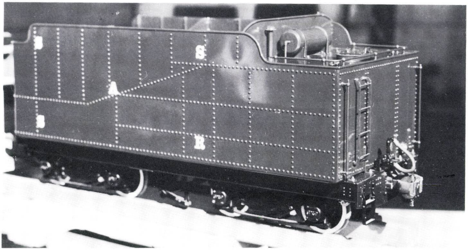
This was made from the SAR drawings with the tank of 16 gauge brass with the sides rivetted to brass angles with the whole lot fixed to a ⅛" thick brass base, with the outer edge curved on a former plate for the correct effect.



The front bogie on the tender. This bogie holds the speedo wiper magnet and sensor.

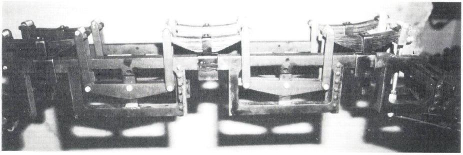


Left: *The 16E tender under construction.*

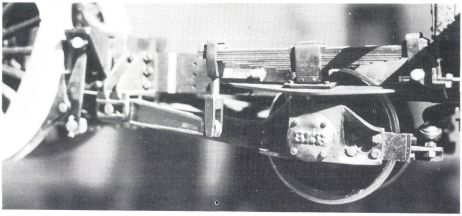


Above: *Completed, painted and lettered.*

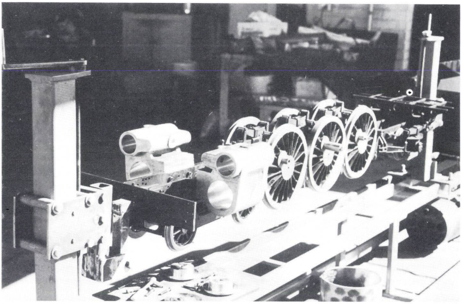
The water space was reduced somewhat as I have made provision for riding on the tender with my feet inside and a coal shovelling chute in the middle. This is a practice I only do when riding on familiar tracks, otherwise I use fold back motor cycle pillion riders foot rests, fixed near the front of the tender underframe.



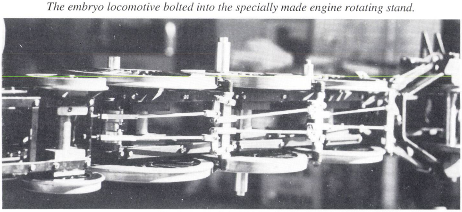
Mid section of the frame in way of the drivers showing springing and equalising arrangement.



The trailing truck with springing and equalising beam.



The embryo locomotive bolted into the specially made engine rotating stand.



The layout of the brake rigging.

The bogies are fully fabricated as per the prototype with full working leaf springs, vacuum brakes — as are also for the train brakes. The engine has separate steam brakes. The axleboxes are fitted with double row sealed ball races.

It wasn't long before the tender was finished, and painted as well. Marvellous!

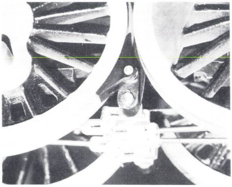
The frame

As I was now retired and able to spend more hours a day in the workshop much could be achieved. Gathering up the mainframes which had been standing in a corner of the workshop for many years (previously being oxy-cut), complete marking out was necessary now from the SAR drawings. Most of these were 1½" to the foot, so transfer was relatively easy. This work has to be exactly right, like the foundations of a building. If this part of the construction is not correct, then everything is out.

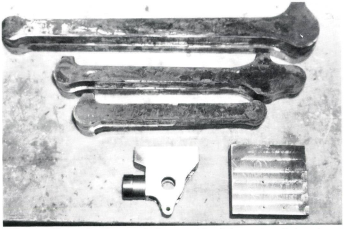
With the two frames bolted together, each being ⅝" thick, and six feet long, things were starting to look big and heavy. Having a large vertical mill the machining of the axlebox horn cheeks and other areas was relatively easy.

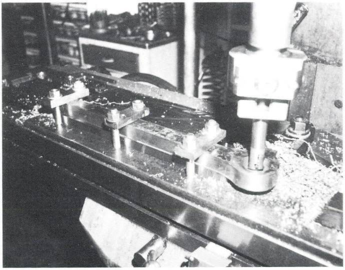
The rotisserie

After bolting the frame together with the stretchers, motion plate, drag and buffer beams, the overall weight began to worry me. How I could comfortably handle it? A chance reading through a MELSA, Maryborough, Qld., newsletter found that a writer had made an adjustable lifting and rotating engine assembling frame for a 5" gauge NSWR 36 class 4-6-0, which was attached at each end of the frame through the drag and buffer beams. This was my way out of any heavy lifting, but first I had to make a trolley long enough to accommodate both the engine and the tender, for movement around the workshop and for the eventual loading into the back of my van. The assembling frames had to be beefed up quite considerably from the one described in the MELSA newsletter, as my engine would finish up a lot heavier than the 5" gauge 36 class. The whole concept proved to be an outstanding success, not only did I build the whole engine on it (except for mounting the



Details of a driving wheel brake shoe.





Above: *Shows the three rods for one side of the engine. Below them is one machined crosshead and one crosshead blank.*
Right: *Showing part of the machining operation on a connecting rod.*

boiler) but could lift it up and down and rotate it 180 degrees, or for that matter any angle.

Running gear

Steady progress was made now, with the turning of the main drivers of 9" diameter, fitting double row sealed bearings on the axles and then into the axleboxes. Positioned in place on the frames, with the horn stays finally bolted in place.

The springing is fully compensated back to the trailing truck, but his has since been disconnected on the advice of Ray Lee, who was quite right in saying that in our models we need more weight on the drivers, whereas in full size practice the weight has to be more evenly distributed.

Braking

Full steam braking on the engine only (vacuum brakes apply to the tender and train) was the next job tackled. The rigging is fully equalised and, boy, this is where the assembly frame first became an asset, as I was now able to rotate the whole engine upside down with ease to work on the dozens of rods, links and pins which make up this type of brakegear.

16E becomes 16F

It was now time to think about valve gear. The prototype 16E class had rotary cam poppet valves, which I felt if transferred to my model would create some headaches. Being a plumber by trade and a self taught model engineer in fitting and turning, considered such an arrangement a bit beyond my scope. Another option was therefore persued. Settling for Walschaert's gear the search started to find a suitable layout. My thoughts went back to the 1989 AALS Convention at the Lake Macquarie, Edgeworth track in NSW, at the time I remember studying in detail and measuring a 7¼" gauge C38 Class, built by the late Les Wood, and found that the wheel diameters, cylinders and valve gear came close to what I was looking for. Dallas King, of the Lake Macquarie club, was good enough to loan me a GA drawing of a 38 — he had just finished building a model in 5" gauge.

At this stage a little explanation is probably the order of the day as to the reason that I classify my engine as a 16F, as I have had some weird feed-back comments that there was no such class. Well, they are quite right! On the South African Railway's locomotive fleet back in 1935, about the time the 16E's were put into service, a 4-8-2 type was introduced classified 15E, with rotary cam poppet valves, as were the 16E's. Later in 1938-9 yet another 4-8-2 type came along, an improvement on the 15E's. Classified 15F these locomotives had Walschaert's valve gear and became a numerous class of 255 in number, for main line working on the SAR. As no class of engine followed the 16E I decided that, in line with the 15E/15F classification, and with similar circumstance of the Walschaert's valve gear, a new class of 16F was the logical solution. I hope that this will now put my critics at ease.

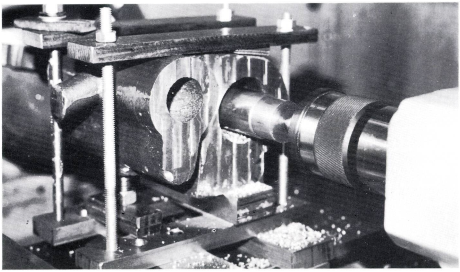
The cylinders

I had the cylinders cast in bronze to reduce corrosion problems associated with cast iron, while the piston valve liners are also of the same material.

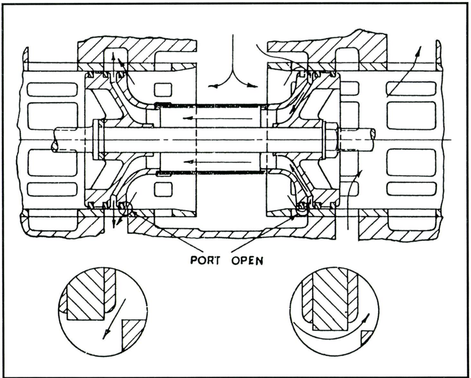
Trick porting

I have been very impressed with the performance of the 38 class which Ray Lee had not long finished building, complete with the trick-porting valve arrangement. Ray was good enough to permit me to drive the engine on a run at his club at West Ryde, Sydney, while visiting there in mid 1988.

Many will know that Ray is an absolute genius when it comes to making unusual parts in modelling, so I naturally turned to him for advice on how he did the trick porting on his engine, which he gladly explained and drew out for me. Following his recommendation has since proved spot-on, with my engine under load, it gives that sharp staccato exhaust beat so characteristic of the prototype.



Above: *Drilling the port passages.*
Left: *Boring the cylinder block..*



The double (or trick) ported piston valve

Many latter day heavy duty superheated locomotives in the U.S. and some in Australia were fitted with trick port piston valves.

Referring to the adjacent diagram, live steam is admitted to the cylinder past the steam edge of the steam port and through the trick port simultaneously, thus providing a large volume of steam at maximum pressure throughout the entire period of steam admission.

Teflon rings

Having had great success with PTFE (Teflon) in my other two engines, *Caribou* and the Norfolk & Western 2-6-6-4, for the piston valve rings, I naturally used the same on the 16F, with outstanding results.

Many readers may be a bit dubious about using Teflon for piston valve rings in lieu of the standard practice of using a metal ring, so now would be a good time to set everyones mind at rest about how they are made and fitted.

Maurie Turner, also of the AMSRS in South Australia, with several other model engineers, including myself, have successfully been using Teflon piston valve rings for some years, with excellent results. As I mentioned earlier these rings have been found to be superior to conventional rings, with no blow and with negligible wear. Virgin grade Teflon is used and provided that you use certain criteria which must be strictly adhered to in the manufacture and fitting all will be well.

The rings — one on each end of the valve bobbin — are quite simple to make, with no split to worry about. As there is probably no other place on a steam locomotive requiring more care regarding fits and surface finish than the piston valve region, good workmanship is essential for their successful operation.

One of the main problems in working with Teflon is the difficulty in obtaining accurate measurements due to the lack of rigidity of the material. Micrometer measurements tend to be unreliable for final sizes and therefore the required fits are best arrived at by "feel", which may require some experimentation at first.

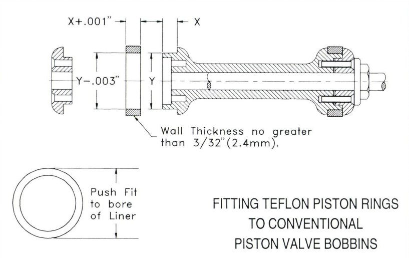
Before starting to make the rings it is of paramount importance to make sure that the bore of the valve liner is parallel and lapped to a smooth polished finish, as any roughness will soon wear the Teflon and lead to leakage, or worse still, may even seize the motion. I found this out when I first tried them on *Caribou,* and have taken special care in the finish of the liner bores since.

Another important point for success is to keep the ring wall on the thin side, to allow for the greater thermal expansion of virgin Teflon. To avoid binding in the liner at operating temperatures experience has shown that the wall thickness should be no more than 0.093", for a 1" dia. bore — scaled accordingly for other bore sizes.

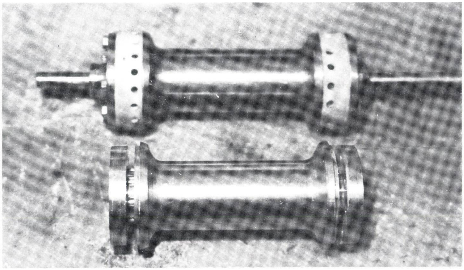
Referring to the diagram below for making the rings, I would strongly advise the following steps to be taken for the best results :

- Turn up a mandrel about 0.003" larger in diameter than the ring landing on the bobbins and stepped to the final length (width) of the ring.
- Chuck a piece of Teflon rod and turn the outside diameter anywhere between 0.005" and 0.010" over the diameter of the finished bore of the valve liner, then bore out the centre to a tight fit on the mandrel.
- Next, face and part off each ring 0.005" to 0.010" over the width of the ring gap on the bobbin.
- Push a ring onto the mandrel and carefully reduce the diameter by taking fine cuts with a sharp tool until the ring is a very neat fit in the liner — a fit which needs to be pushed in with the thumbs with little resistance. Using the same tool setting, machine the other rings to give the same push fit.
- Finally, replace each ring in turn on the mandrel up against the shoulder, face the width to a tight fit in the gap on the bobbin.
- The rings are fitted to the piston valve bobbin, which is illustrated on the sketch, they have no side clearance. They do have about 0.003" clearance on the diameter of the bobbin, so that they expand inwards when they obtain operating temperature, while at the same time maintaining a perfect seal against the bore of the liner.

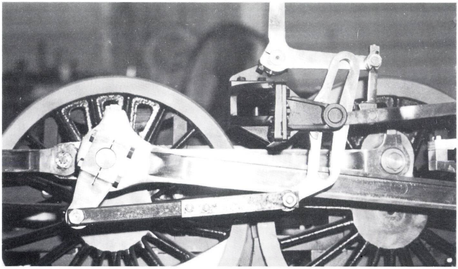
The rings are of course plain, with no grooves and should be lubricated with light oil on assembly in the liner. It is important for long, trouble free running with


X+.001"
X
Y-.003"
Y
Wall Thickness no greater than 3/32"(2.4mm).
Push Fit to bore of Liner

FITTING TEFLON PISTON RINGS TO CONVENTIONAL PISTON VALVE BOBBINS



Top shows a piston valve assembly complete and ready for installation in the 16F. The lower is the centre spool piece of the other valve bobbin.



The right hand side showing the reversing links, expansion link and the adjustable eccentric rod, used to set the finished centres on the permanent eccentric rod after the valve timing is set.

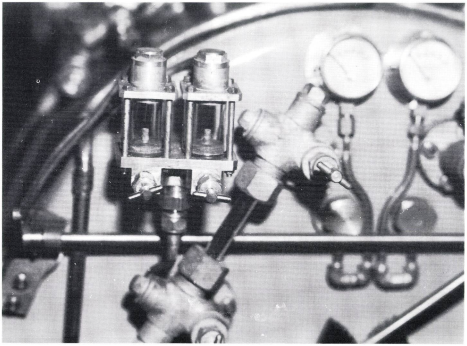
these Teflon rings to make sure that the snifter, or drifting valve, is of ample size to avoid ashes being drawn down into the valve space when coasting with the regulator closed.

This is how I made the Teflon piston rings for my three engines, which came from an article written by the then President of the AMSRS, Glen Culley, back in September 1993 for our club magazine, *Narrow Gauge*.

Lubrication

While the general trend is mechanical lubrication, my *Caribou* and the N&W 2-6-6-4 articulated, have sight-feed hydrostatic lubricators. These have proved very successful over the years. Basil Palmer in South Africa produced a magnificent four-sight glass Detroit hydrostatic lubricator for his 16E as the originals had, but I settled for a simple twin sight feed type described in *Model Engineer* Vol 133, 1967 by Fred Cottam, and it works well. The beauty of this type is that the amount of oil can be controlled so that the driver and the engine do not get covered with excess oil as with some of the mechanical types.

Below: *Part of the boiler backhead with the two sight feed lubricators prominent.*



Power Reverser

Since I decided to put Walschaerts valve gear on the loco, and, knowing that most locos of this size had some form of power assist on the reversing gear, I decided to do the same.

The power reverser is patterned on the Franklin prototype and construction was covered in detail in *Modeltec* magazine some years ago (see the *Modeltec* ad on page 7). It is a steam operated precision position assist reverser and the cut-off can be precisely set, as it mirrors the position of the quadrant reversing lever in the loco cab.

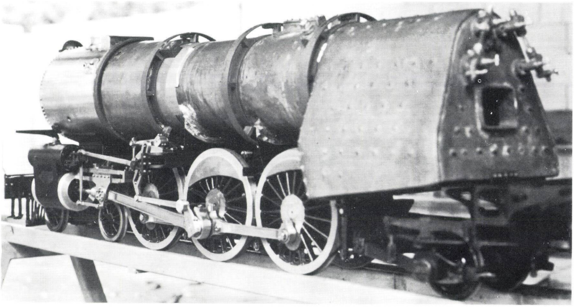
The reverser is located in the usual position on the drivers side footwalk mid way along the boiler flanks.

[Copyright prevents us from reproducing details of the reverser. However, the article was titled "Power Reverser" by Johnny Black, published in the January 1985 issue of *Modeltec*, a US publication. ... ed.]

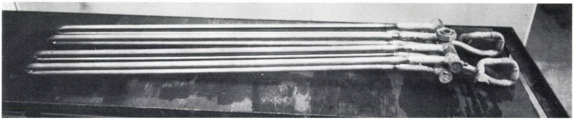
The Boiler

Being a plumber my natural choice was of course copper, one of the best metals that man can work with. To fall in line with the rest of the engine I had to follow as close as possible the SAR boiler drawings for the 16E. The boilers were massive, fitted with a standard 3A type, diameter 6'2½", pitched at 9'3" above the rail head to accommodate the large six foot diameter driving wheels (the largest driving wheels on 3'6" gauge in the World), these were the highest of any engine on the SAR. Other notable characteristics were, 19 feet between the tubeplates, with 63 square feet of grate area, and *hand* fired.

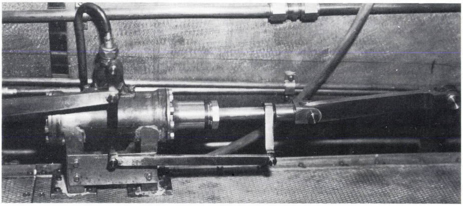
To follow the AMBSC Code Part 1, Copper, I had to redesign the boiler to suit my model, while retaining the firebox area dimensions. The barrel had to be reduced from the scaled down 9½" diameter (from the drawings) to 8" to comply with Part 1 of the code. This gave the back an unusual shape, but this was later rectified by the cladding and a false



The huge dimensions of the firebox are readily apparent in the adjacent view of the completed boiler sitting in the engine frame. Note the circumferential rings along the barrel which will later support the boiler cladding after the lead sheeting (ballast) and insulation wool has been fitted..



The superheater elements for the 16F's boiler. The authors experience in the plumbing trade is apparent when looking at the pipework around the superheater headers with it's multitude of silver soldered joints.



The power reverser unit on the 16F.

backhead cover. My model boiler finished up with a parallel barrel 8" diameter 1/8" thick tube; no combustion chamber; four x 1 1/4" diameter superheater flue tubes and 16 x 3/4" diameter fire tubes. The outer firebox wrapper in 3/16" plate, as is the inner firebox, while the backhead is 1/4" copper plate as for the others. The superheater elements are made from 1/2" diameter 316 grade stainless steel with spear ends, TIG welded. Because of the space created from the reduced boiler diameter, and the outer cladding wrapper of over 10" diameter the opportunity was taken to add some extra weight to the engine for better traction. My opinion has always been that the copper boilers we make for our models are far too light in comparison to the same if made from steel, in terms of weight to strength ratio. With this in mind I proceeded to wrap the boiler barrel with sheet lead, building up the space under the cladding with a total of 42 kg of lead! Lagging was finished off with Kaowool.

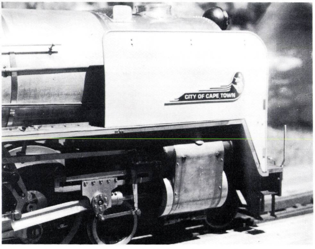
A must for a boiler of this size is an arch. This was made from 3/16" heat resistant stainless steel plate, resting on lugs brazed to the firebox sides and extending from 1" above the grate two thirds along the length of the firebox, to about 3" from the crown at the firehole door end. Experimenting with several types of grate of varying spacings of anything up to 3/8", mostly cast iron, have been found to warp beyond belief when using char (our best fuel at a price here in South Australia). With some trepidation I am now using, quite successfully, grates made from ordinary mild steel, 1" deep x 3/16" thick with 1/8" spacings. These have lasted many months now with no apparent wear or distortion, and using only char, as any other fuel would block up the grate very quickly.

Boiler feed

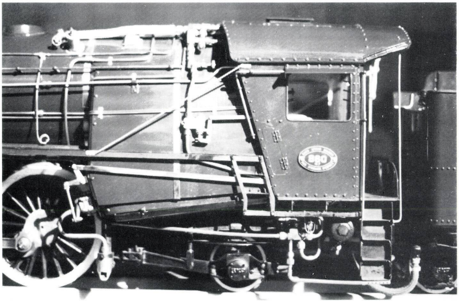
The boiler feed is supplied by two large injectors, made locally, which have no trouble in keeping a good water level when the engine is steaming hard. Steam for the injectors is via the turret through two *Sellers* type quick acting steam valves, designed by Basil Palmer and described in the *Model Engineer* May 1976. I found his original design to be too small capacity, not letting enough steam through. So I made two more 25% larger, and have had no further trouble.

Speedometer

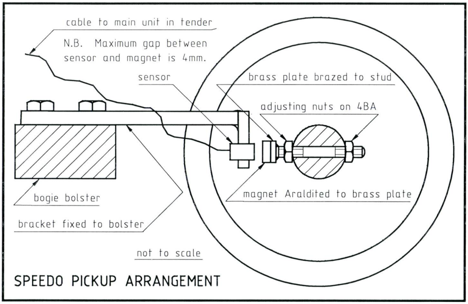
readers of this article might be interested in the process of fitting of the 16F with a speedometer and distance meter. The type I use is



Impressive from any angle, including this view looking forward along the smoke deflector. The author has named his 16F ***City of Cape Town*****.**



Around the cab area of locomotive 860, showing the multitude of valves and fittings Prominent in the centre of the picture is the Sellers steam valve for the feedwater injector.


cable to main unit in tender
N.B. Maximum gap between sensor and magnet is 4mm.
sensor
brass plate brazed to stud
adjusting nuts on 4BA
bogie bolster
magnet Araldited to brass plate
bracket fixed to bolster
not to scale
SPEEDO PICKUP ARRANGEMENT

actually a bicycle cyclo-computer of the Cateye® make (model CC ST 300), a good alternative is a Sigma® (Sports Model BC 700). Both these types have seven functions: speed (km/hr); trip distance (km.); total distance (km.); clock; trip time; maximum speed; average speed. The secret is to get one with the wheel diameter calibrated in mm (not cm), as you need to be able to calculate the circumference of a wheel down to below 3" dia. in some cases. I fitted a magnet and sensor to the front axle of the front bogie of the tender, which is away from the heat of the boiler. As the size of the dial face is about the size of a matchbox I placed it in a convenient location at the front of the tender, making it easier to read. A good average running speed on any public running day at our club at Railway Park, Prospect in Adelaide, South Australia, is between 8 and 10 km/hr, while the distance travelled would be about 12 km.

Mainline operation

Persistence saw the engine completed for trials — unpainted, the tender made and painted a number of years ago — by December 1993. Following a few hiccups and adjustments it soon proved to be an exceptional locomotive, and big! Early in 1994, after being satisfied that everything would work, I finalised the painting of the engine itself, this being mainly the boiler, cab and smoke deflectors, in the South African Railways *Blue Train* livery, as is of course the tender. I thought that it would be a nice change from black, the colour of my other two engines. The rest of the painting having been done during assembly, so as not to have to pull everything apart again. This was all completed in time to embark with it on a tour to the 1994 AALS Easter Convention in NSW at Wollongong.

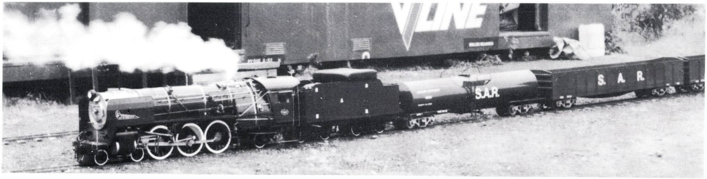
In the first twelve months of running, the 16F steamed 312.62 kilometres, which included 32.7 kilometres at the Illawarra Live Steam Convention, a visit to West Ryde SLSLS (11.6 km.) where they run heavy passenger trains to a tight schedule, the locomotive effortlessly worked their six cars sets for the afternoon. Last run was at Hornsby and District Model Eng. Soc. (2.75 km.)

The hauling capacity for normal public running is quite easily maintained with an auxiliary water tank car holding 93 litres (21 gallons) and five 6ft. passenger cars. The total weight with an average mixture of adults and children would be approximately two tons. More cars could be added without problem, but this is not possible due to limitations of club station and track.

Conclusion

Reflecting on the project, it has been one of great interest throughout. In hindsight I wouldn't alter any of the steps taken, and the result has given immense satisfaction with the performance of the engine surpassing all my expectations. I did not think for one moment that it would be so efficient both in steaming qualities and hauling capacity. Probably the main reason for this for this is its sheer size, the South African loading gauge being very generous.

Any other modeller contemplating a South African Railways prototype should bear in mind that a very large but extremely satisfying locomotive will be the end result.



Class 16E 4-6-2

of the South African Railways

compiled by John Wakefield

From the late 1920s through to the 1940s there was a world-wide tendency for railway administrators/politicians to build glamorous locomotives for prestige passenger train services.

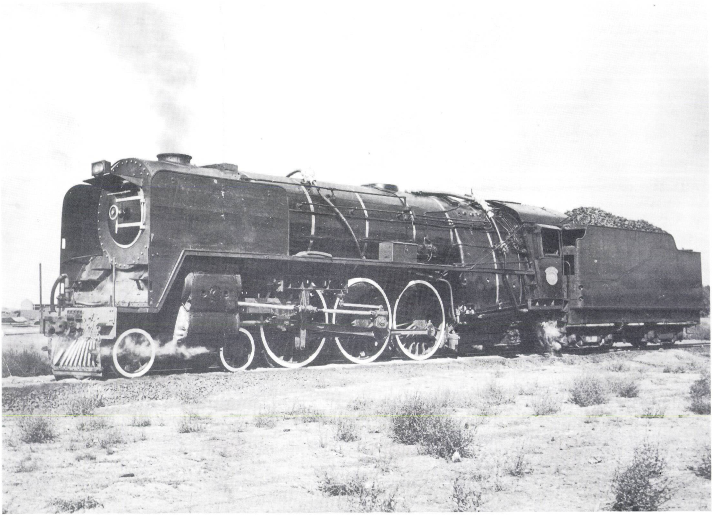
Naturally, these prestige engines were designed to haul crack passenger trains on their respective systems. It was with the foregoing in mind that Mr A. G. Watson, Chief Mechanical Engineer of the SAR from 1929 to 1936, designed the 16E Class. They were built by Henschel & Sohn of Germany and delivered in 1935. They were intended primarily to improve the Cape Town - Johannesburg service by higher speeds, hauling the fast passenger trains like the *Union Limited* and the *Union Express*, fore-runners of the now famous *Blue Train*.

A point often overlooked (by wise in hindsight critics), is that Mr Watson, by introducing the 16E was merely keeping abreast of world trends in locomotive practice at that time. If railways overseas could run glamourous prestige trains hauled by suchlike locomotives, then why not the SAR.

The 16Es (Nos. 854-859, being only six in the class), were placed in traffic in 1935 and stabled at Kimberley Locomotive Depot. They were assigned express train workings on the section south, through De Aar to Beaufort West and north to Johannesburg. As originally delivered the 16Es were a mixture of American, English and German design, with heavy bar frames, smooth boiler casing and one which was most imposing with a centre line 9ft 3 inches above rail level, the highest pitched boilers on the SAR made necessary by the six foor drivers.

Because of this, and the loading gauge limitations which, at 13' high and 10' wide, was quite generous for 3'6" gauge, it was impossible to fit a normal dome and its place was taken by an inspection manhole. The steam is collected through numerous small feeder pipes fixed into two collector pipes which are arranged as high as possible above the water surface. The collector pipes join together to form a main steam pipe 7" in diameter, which leads to the superheater header and multiple valve regulator situated in the smokebox.

With these Pacifics producing a tractive effort of 35280 lbs it must have been a massive job for the fireman to hand fire. These engines with 63 square foot of grate (compared to NSWR C-38 with a 47 square foot grate), and the very high ash content of the South African coal, fired from a tender holding 14 tons of coal and 6000 gallons of water. This was to be the greatest failing of these engines, together with the high axle load of 23 tons, and they were displaced from most prestige workings after a few years in 1939. Their replacement



A classic study of South Africa's largest and last class of Pacific (4-6-2) locomotives, the 16E No. 858. Shown here in modified form with smoke deflectors and standard funnel. Note the poppet valve gear operating shaft from the main driver mounted gearbox to just below the steam chest.
Photo. SATS ref. # 81372

were the 23 class, a massive 4-8-2, which had the same grate area but also had a mechanical stoker, and could run at the same speeds allowed of the 16Es.

A number of minor alteration were made over the years, the earliest being the change from the nicely flared chimneys to the standard type, and the fitting of smoke deflectors, which drasically altered their appearance.

The 16Es represented the maximum development of the pacific type locomotive on the SAR. With the 6'0" dia. coupled wheels, the largest on a 3'6" gauge railway anywhere in the world. No 854, soon after being placed in traffic, attained speeds on test in excess of 85 miles per hour (136.8 km/hr) with the regulator only half open and a trailing load of 350 tons. The test engineers and driver were satisfied that she would have exceeded 100 miles per hour (160 km/hr) if track conditions had been safe enough for an attempt and if the fireman could have kept up the firing rate. Be that as it may, such high speeds were not practical or safe in daily service. Thus it follows that the full capabilities of the 16E could not be exploited on the SAR rails with the maximum speed on the main lines at 60 miles/hour (100 km/hr) So as can be seen, in a nutshell, whilst the 16E was in itself a magnificent example of a high speed express passenger locomotive, its full potential was never realised.

The 16Es remained in frontline service on the Cape Northern System (Beaufort West to Johannesburg) until 1939 when all steel air conditioned stock for the *Union Limited* arrived, later to be known as the *Blue Train.* This stock was too heavy for these engines to handle and their work was taken over by the more powerful 23 class locomotives.

They were subsequently transferred to Bloemfontien, where they continued to work mainly passenger trains, and were quite often seen at the head of the *Orange Express* heading across to Kimberley, their old depot. To avoid misconceptions, these engines also did considerable light goods work. However, they were finally relegated to pick-up goods between Bloemfontein and Noupoort, before being withdrawn from service in 1972.

Basically, the final demise of the 16Es was accelerated by the fact that eight coupled engines could easily achieve the allowable maximum of 60 miles/hour (100 km/hr) and more. Thus, in the circumstances, special locomotives for the haulage of passenger trains were not required.

Two of the 16Es remain. After official retirement, No.858 was painstakingly restored at De Aar by the then locomotive depot foreman, Alec Watson, to its original as built state. From 1976 it ran like that on special trains for some years until Alec's death. It was then overhauled again, and the smoke deflectors and standard chimney refitted.

No.857 stood from about 1973 until 1989 on a plinth outside Bloemfontein Station. She was then removed and taken to the locomotive depot for repairs before returning to prestige train duties in late 1990. As far as is known only two engines of this class were officially named, No. 858 *Allan G. Watson* and No. 857 *Ann Smith.* Although others have had names put on them by their regular drivers, a common practice in South Africa.

Locomotive Data

The locomotive data is shown adjacent. So that readers gan get an idea of the size and power of the locomotive, principal data of the NSWR C-38 class is also shown as a comparison, purely because the 38s are well known to Australian and New Zealand enthusiasts.

Note that the Tractive Effort of the 16E is at 75% boiler pressure while the C-38 is quoted at 85% WP. If the tractive efforts were compared at the same percentage of working pressure, then the 16E's rating would be substantially higher than that of the C-38!

Specifications

	SAR 16E	NSW C38
Contract Price	£7,933 (1935)	£19,844(1) (1943)
Cylinders	(2) 24 x 28	(2)21½ x 26
Driver Diameter	6'0"	5'9"
Steam W.P.	210psi	245psi
Tractive Effort	35,280 @ 75% W.P.	36,270 @ 85% W.P.
Total Heating Surface Area	2914 sq.ft.	3367 sq.ft.
Grate Area	63 sq.ft.	47 sq.ft.
Valve Gear	R.C. Poppet	Walschaerts
Coal Capacity	14 tons	14 tons
Water Capacity	6,000 gals.	8,100 gals.
Working Weight	167 tons	201 tons(2)
Length Overall	71'8"	76'4⅝"

(1) This figure may have beeen varied.

(2) Streamlined , 195 tons unstreamlined

References:

Steam Locomotives of the South African Railways Vol 2 1910 - 1955 by D.F.Holland

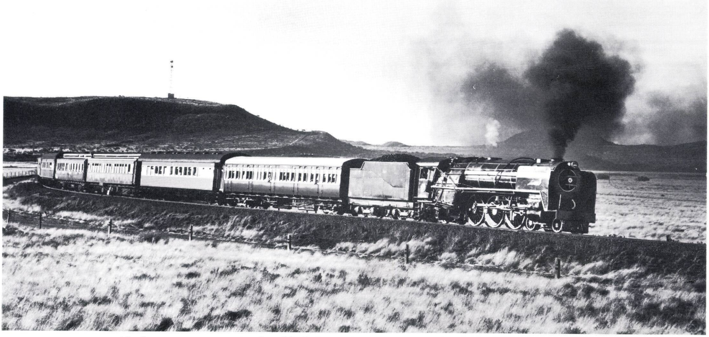
South Africa - Last Stronghold of Steam, published by South African Transport Services.

Twighlight of South African Steam by AE Durrant

The Sunset of Steam by Dennis Moore.

38 by John B. Thompson

A Compendium of NSW Steam Locomotives compiled by Alex Grunbach, published by the ARHS, NSW Division



The last passenger run of a class 16E before withdrawal from regular service in December 1972. Locomotive No.857 is in charge with eleven coaches in tow between Bloemfontein and Kimberley.

Photo. A. Jorgensen

Club Roundup

Maryborough Qld

Members of MELSA and their out of town visitors have so much fun on the two times a year that they get together that they have decided to do it more often. As from last November MELSA has three two-day weekends in conjunction with their normal track days. The idea is that the Saturday is to be a social day for members, families and visitors and the Sunday is the normal public running day. These weekends will tie in with the last Sunday in March, July and November. The November weekend was a great success. Another change regular visitors to Maryborough will notice is that the running direction alternates with each run and that the club have installed ground level throw-over point levers on the most frequently used points.

Two members of MELSA have recently passed away, Warwick Dore of Roma and Lew Blackmore of Buderim. Many model engineers from throughout the world would be familiar with Lew's work and his internal combustion aero engines. Several years ago he won the Duke of Edinburgh Cup at the Model Engineer Exhibition in England for a Bristol BR-2 rotary engine. The construction of this engine was subsequently serialised in the Model Engineer and a book of these articles has been published.

MELSA is a high profile club in the Maryborough community, enjoying the same status as the local service clubs. After all operating expenses are met the club regularly makes substantial donations to charities and needy causes. The public running days held in conjunction with a local band have officially been listed as one of the two most popular tourist attractions.

Model Engineers and Live Steamers Association, Maryborough Inc.
Location: Queens Park, Maryborough
Public running: Last Sunday of each month

Tauranga NZ

The best club night ever! That is how the majority of members describe a recent welding demonstration. Two suppliers' representatives started the day with a quiet run on the club track to get an idea of what the hobby is about. In the evening members were treated to a demonstration of gas welding and brazing aluminium, die cast alloys, stainless steels, cast iron, copper and brass in all combinations.

Track work is progressing on two spurs between the high and ground level tracks with consideration being given to leading one spur onto the ground level track by way of spring points. Handrails are being installed over the tunnel.

Tauranga Model Marine and Engineering Club
Location: Memorial Park, Tauranga
Public running: Unknown

Edgeworth NSW

The Lake Macquarie members are certainly a busy lot. 'Mug's Flat Siding' has now been created on the 7¼" track. This siding is all that remains of the old mainline and was created when the 7¼" main line was relocated to a new alignment on a larger radius. Its purpose is to give drivers of locos room to stop if they miss setting the point for the inner loop.

A siding has been laid at the departure end of No 2 platform on the 5", another storage track in the loco shed has been converted to dual gauge and a fence has been erected from the new footbridge beside the 3½" up to the existing footbridge. On the 5" the points which control trains coming off the hill and rejoining the main line have been increased from 27 to 45 foot radius. Also on the 7¼" the main line has been moved to a larger radius with two new diamond crossings and a connecting track laid to allow trains from the bush direct access to station tracks. Paint brushes have been working overtime everywhere.

At the last AGM the board of directors remained unchanged. They are President: Tom Burns, Secretary: Joe Huntley, Treasurer: Ian Bartle and Directors: Rod Scaife, Wayne Patfield, Bob Percival and Boyd Osmond.

Club member Dallas King's Blowfly was voted the most popular at the blowfly rally in Mudgee.

Lake Macquarie Live Steam Locomotive Co-op Society Ltd.
Location: Off Velinda Street, Edgeworth
Public running: Last Sunday of every month except December

Invercargill NZ

The Southland club, like many throughout Australia and New Zealand has experienced a spate of vandalism. In their case, 16 windows broken, two outside security lights ripped out and boards broken off the boundary fence.

Although the weather was not very good, there was one notable feature of the recent Loco Trials. The lady drivers annihilated the men with only one man able to hold his head up!

With the renaming of New Zealand Rail to Tranz Rail members are chasing new colours and logos for their models. They are also gearing up for the 10th annual Great Little Train Show in March. This popular event provides an important part of the club's income.

Southland Society of Model Engineers Inc.
Location: Surrey Park, Invercargill
Public running: Unknown

San Francisco USA

The land use agreement with the East Bay Regional Park District made in 1974-76, expires in 2001. A committee is exploring an extension with five years now being the length of agreements in accordance with EBRP policy. Also part of policy is the possibility of one or two five year extension options.

The club has recently imported a few tons of Welsh steam coal from England.

Golden Gate Live Steamers Inc.
Location: Loma Cantadas and Grizzly Peak Boulevard, Tilden Park, Berkley, California.

Castledare WA

Members reflect on an eventful 1995. They survived a disastrous fire which destroyed most of the wetlands area. Two weddings were held on site, and the year also saw Castledare flooded with the highest water level for many years. As in other clubs, vandalism was also a problem.

Castledare Miniature Railway
Location: rear of 100 Fern Road, Wilson
Public running: 1st Sunday of month 11am-4pm

West Ryde NSW

The workers have been busy at Sydney Live Steamers. Signals nos. 8 and 10 have been connected to the ground frame which means seven out of the ten levers now perform useful functions. (This club's signalling was featured in AME issue 63). Work has

Club Roundup contributions

AME is pleased to receive club newsletters for consideration in this section. Newsletters are often a good source of articles, which we appreciate all the more, but most of all they help us keep in touch.

It is often difficult to decide what to publish and what to leave out. and the task of selecting material for a wider audience takes a lot of time. Also, there is always the risk that AME will publish something that the club considers sensitive. Please help by sending a "press release" page with your newsletter, or highlight the items you think we could use. We'll give first preference to clubs that help us out this way.

bmc

started on handrails and access to the signal box in an effort to improve safety and appearance.

Members have been urged to minimise chances of insurance claims for "cinders in the eye" which another club was hit with recently. The word is if you burn briquettes or char, do not burn the fines, do not work the locomotive too hard, do not rake the fire on the run, and if you notice sparks reduce the load.

Sydney Live Steam Locomotive Society
Location: Anthony Road, West Ryde
Public running: 3rd Saturday of each month

Gisborne Vic

The Tractor Pull scheduled for 12 November was cancelled as 3" of rain in 36 hours was too much for the ground. The Tractor Pull is now going to be held in conjunction with the next Steam Rally on 19 May, 1996. It is also proposed to hold an A. H. McDonald Rally in late 1996, open to A. H. McDonald machinery such as stationary engines, rollers and tractors. The Society is also looking at constructing their own 2ft gauge bogies for about a quarter of the price of buying them.

Gisborne District Steam and Engine Society Inc.
Location: Webb Crescent, New Gisborne
Public running: 1st Sunday of each month.

Moorabbin Vic

There was a good turnout of members on 18 November. the Marcus Traylen Trophy was won by David Smith with his QR A-10 locomotive. Members are gearing up for the 1996 Model Railway Exhibition at Camberwell in which they are regular participants.

The following quote comes from club Safety Officer, Ron O'Shannessy. "Of course there have been winter gales and storms and fog and the like, but in all my experience I have never been in any accident worth speaking about. I have seen but one vessel in distress in all my years at sea. I never saw a wreck and never have been wrecked, nor was I ever in a predicament that threatened to end in disaster of any sort." The speaker was Captain E .J. Smith in 1907. When the Titanic sank in 1912 with the loss of 1500 lives one of them was its Captain......E. J. Smith! Get the point!

Steam Locomotive Society of Victoria Inc.
Location: 128 Rowans Road, Moorabbin
Public running: 1st Sunday of each month

Tullamarine Vic

The club is celebrating its 21st birthday with a steam up on 3 March. All visitors are welcome.

The Tullamarine members should not find meeting nights boring. The activities lined up for club nights for the rest of the year include Two stroke motor cycle engines (March), Woodworking Machinery (April), Loctite® Anaerobic Adhesives (May), AGM and models on the table (June), Foundry practice and demo (July), Auction Night (August), Modern Adhesives for Model Making and Engineering (Sept), Tools and model parts Auction (Oct), Articulated Railway Vehicles and Bogie Design (Nov), Exhibition and Trophies (Dec). Must be some ideas there for others to think about!

Tullamarine Live Steam Society
Location: Springbank Street, Tullamarine
Public running: 1st Sunday of each month.

Bribie Island Qld

This is another club of doers. In the past year they have completed track extensions, the turntable roads are lengthened and supplied with 240/12 volt power, compressed air and water, and several passenger wagons have been built. The QR passenger brake van has been done up into a canteen/library with sleeping area.

The October two day run was popular, with several Toowoomba members bringing locos. Everyone enjoyed a night run after the BBQ on the Saturday.

Model Engineers and Live Steamers Association Inc, Bribie Island
Location: Toorbul Street, Bongaree, Bribie Island
Public running: 3rd Sunday of each month.

Western Port Vic

At the BHP Western Port Railway Society's AGM held last November, the following office bearers were elected. President: Gerald Spoor. Secretary: Jim Dodd. Treasurer: Ian Wilson.

One of the first duties the new president performed was the presentation of Foundation Membership to Ian Wilson, and Honorary Membership to Arthur Jenkinson and Kel Heath.

BHP Western Port Railway Society
Location: Denham Rd. Hastings.
Public running: None

Coming Events

2 March
BHPWPMRS All-comers Day

Come and join the BHP Western port Model Railway Society at Denham Road, Hastings (Melway 155A) for a great day. Contact Gerry Spoor, Private Bag 1 Hastings, Victoria, 3915, for details.

2, 3 March
10th Great Little Train Show

Invercargill, NZ. Further details from Secretary, PO Box 216, Invercargill, NZ.

3 March
21st Birthday Steam up Party, Tullamarine, Vic

Running from 1pm to 7pm. Visiting engines welcome!

9, 10 March
Tauranga Open Weekend, NZ

Memorial Park, Tauranga. 2½", 3½" and 5" raised tracks and 5" and 7¼" ground level tracks. Barbecue tea, night running to 10pm (tail lights required)

30, 31 March
MELSA Steam Weekend

Queens Park, Maryborough Qld. 9am to whenever both days, BBQ Sat evening public running Sunday. (Enquiries David Proctor (071)213832).

4 to 7 April
National AALS Convention, Penfield, SA

Contact: Convention Secretary, Penfield Model Engineers Soc. PO Box 792 Salisbury, SA. 5108. A reminder that registration forms for meals should be placed by 7 March

17 to 21 April
Maitland Steam Fest

All Welcome!! Especially exhibitors of steam models of all types. This award winning festival features many facets of life around the steam era. If you can't exhibit then come and look around. Contact Bob Neal (049) 32 8507 or Terry O'Neill (049) 263808 for information about exhibiting or what's on.

16 to 19 May
Hare & Forbes, Parramatta, NSW, 3rd annual sale and model engineering display

See metal and wood turning demonstrations by experienced operators. Rotary club barbeque. HDMES members' display of projects.

18, 19 May
Gisborne Vintage Engine Rally and Tractor Pull

Steam Park, Webb Cres, New Gisborne, Vic. Society Secretary, Barry Thomas (054) 28 7047

continued left...

Coming Events continued...

1, 2 June
Hobby & Handcraft Expo, Orange NSW

Orange Function Centre, 9am to 4pm. All types of craft and modelling on display, plus trade stands. Orange Soc. of Model Engineers track run from 5pm on Saturday. Admission to Expo Adults $3, Children and pensioners $1.50. Family pass (2 Adults 3 Ch.) $9. Proceeds to restoration loco 5112 and train of FS cars. Bill Marshall (063) 623185.

5, 6 October
3rd Model Engineering Exhibition

Monash University, Melbourne
Exhibitors Wanted Contact:
Robert Jones (03) 9801 6048.

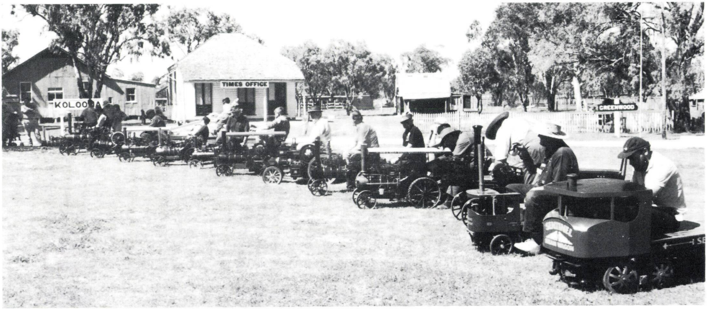
19,20 October
8th Miniature Traction Engine Rally

Inverell Poineer Village, Inverell, NSW. Contact: Gordon Blake (067) 22 4277.

Inverell Turns It On For Traction Engines

by Hugh Carseldine

Photos by Brian Carter unless otherwise noted



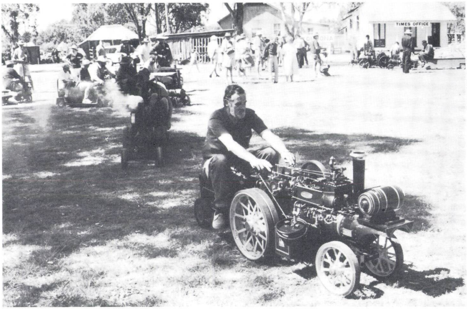
The advertisement said "The 7th Miniature Traction Engine Rally will be held at Inverell". Inver-where? Let's look at the atlas. Gee! About 400km south of Brisbane, 600km north of Sydney and 250km from the coast. Who would travel that far? Well, to jump ahead a bit, everybody who went will almost certainly come back this year!

I first thought of going there during the annual Steam Heritage Day in June 1995. The organisers, Gordon Blake and Bob White, paid us a visit at the Petrie Steam shed just north of Brisbane.

What they told us whetted the appetite, but I was still not totally convinced.

At Gordon's place on Friday night, with 40 other guests, I realised that I hadn't taken account of the Inverell Hospitality Factor. We had a marvellous barbecue, to which Gordon added a master touch.

"Come outside for the fireworks", he announced. Oh yes — are they going to give us a sparkler each? Next, a gigantic pyrotechnic firestorm exploded over the city — and continued for twenty minutes! Little did we realise it was the opener for the district's Sapphire Festival!



Mike New leading the parade on Saturday with his Fowler road locomotive.

The big day

Saturday morning: off to the action at the Pioneer Village. If someone was asked to design a venue for a miniature traction engine rally they couldn't do better than this one: the surroundings were superb.

And so was the organising. Free fuel was available for machines and humans. The Oakwood Memorial Hall displayed partly-built engines, Ernest and Joan Winter [*well-known AME advertisers... ed*] had set up a good trade stand. The Inverell Model Railway Club set up a magnificent HO gauge electric layout. There was even a display of interest to steam drivers who have not yet learnt how to steer — an almost completed 5" gauge NSW 38 class loco.

Outside the scene was filled with nostalgia. The Pioneer village, with its unique buildings, all native to the district, was a perfect backdrop to the miniature traction engines slowly travelling down the well prepared gravel road.

The village

The buildings comprise the Nullamanna church, the Goonoowigall school, the village store, *The Grove* homestead (with its stringybark roof, it's the oldest building on site, built in 1841), Paddy's Pub (originally on the road between Inverell and Bundarra), Shadwell Hills Kitchen, *The Times* printing office, Aberfoyle Telephone Exchange, Keera Blacksmith shop, Pindaroi Farriers shop and shearing shed, The Gournama Homestead, a miner's hut, the Oakwood Memorial Hall and Inverell Railway Station (under restoration as the new home of the Inverell Model Railway Club).

Chris Wilson and his Sentinal wagon.

Traction Engineers and their Steeds

State	Name	Scale	Engine
Qld	R. Campbell	3"	Allchin TE (static display)
	Hugh Carseldine	3"	Cliff & Bunting TE
	Mark Mills	3"	Case portable
	Ray Schilling	3"	Cliff & Bunting TE
	Chris Wilson	4"	Sentinel undertype steam wagon
NSW	Gordon Blake	3"	Cliff & Bunting TE
	Alan Chapman	3"	Foden overtype steam wagon
	Ken Connon	3"	Burrell TE
		3"	Atkinson wagon
	Bill Heard	3"	Cliff & Bunting TE (Stephenson's valve gear)
	Robert Henderson	3"	Cliff & Bunting TE
	Col Jones	3"	Allchin TE *Royal Chester*
	Andrew McLeod	3"	Cliff & Bunting TE
	Bob McLeod	4"	Freelance TE
	Mike New	3"	Fowler Road Locomotive *Princess*
	John Oliver		Allchin TE (under construction)
	Peter Smith	4½"	Allchin TE (cover story of AME issue 62)
	Victor Scicluna	3"	Cliff & Bunting TE
	Colin Weir	1½"	Allchin TE (static display)
	Bob White	3"	Cliff & Bunting TE
	Ernest Winter	1½"	Allchin TE (static display)
SA	John Levers	3"	Buffalo Pitts TE

Although there were several modellers from Victoria present, none had brought an engine with them. Our apologies if someone has been inadvertently left off the list...ed.

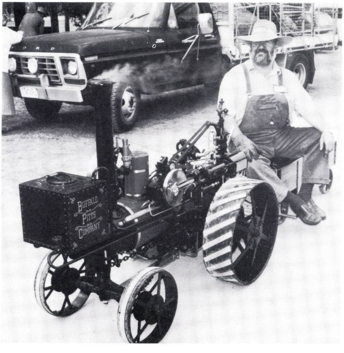
The buildings weren't merely shells — they contained all the items appropriate to the era and type of building. You could sit in a school desk with slate or post office pen and image how the children of the late nineteenth century attended school. You could see the early printing machines. The dentist equipment was like something out of a horror movie! There was a very well presented memorial presentation of military artifacts.

Around two sides of the village, a cover had been erected to protect the exhibits awaiting restoration. Needless to say, there are plenty of projects to keep the pioneer village team busy for many years.

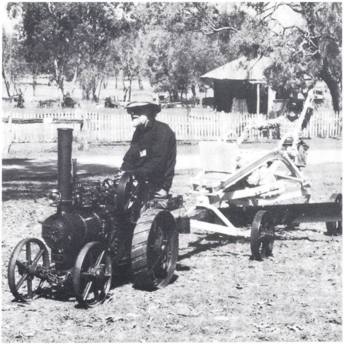
A centre-piece of the village is a man-made lake. The steel girder bridge spanning it was thought to have come from England at the turn of the century. The bridge spent its "working life" spanning the Slaughter House Creek at Biniguy. To conform with the era, the bridge is painted grey — so as not to frighten horses! It provides an interesting path for the model engines as they traverse the timber deck. The lake would be suitable for model ships!

The engines

Many model traction engines with owners and families attended the rally. During the afternoon, most of them lined up on a level display area for a group photo: it needed a very wide angle lens to fit them all in!

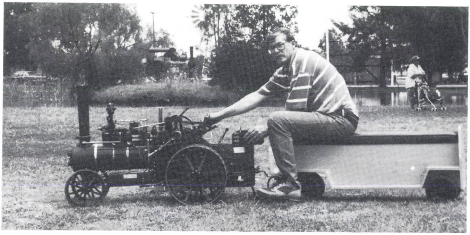


John Levers with his recently completed Buffalo Pitts engine.



Bob McLeod towing the village's road grader with his freelance engine

One of the event organisers, Bob White, driving his Cliff & Bunting.



Victor Scicluna at the throttle of his Cliff & Bunting.

The award for the furthest travelled would go to John Levers of Adelaide. John brought along his recently completed Buffalo Pitts engine. John Dew from Live Steam Supplies of Victoria was there with his family (*see their Cliff & Bunting display ad in this issue... ed*). John's daughter Kellie is building a 4" scale Aveling & Porter steam roller, which we hope to see when it's finished.

The rest of the traction engine owners came from Queensland and New South Wales. There were many prospective owners, just dreaming about having a model engine. They enjoyed themselves just as much as the traction engineers.

More than one hundred people sat down to Saturday night's barbecue, ably cooked by Andrew Fuller and helpers. During the dinner there was an informal welcome by the Mayor of the city of Inverell.

Welcome

His Worship the Mayor, Bill Vincent, declared that it was a great privilege for Inverell to host the 7th National Rally! When he had heard that the previous six rallies had been in Melbourne he wondered why they were coming to Inverell. But when he saw the engines running through the pioneer village earlier in the day, he couldn't imagine a more suitable venue. He also said that the rally was a fitting start to the district's annual Sapphire Festival. Gordon Blake thanked everyone for participating in the event and for making it such a resounding success.

Snippets of overheard dinner conversations proved interesting.

- "We left Adelaide the day before yesterday to bring our engine here".
- "So that's how you fit Stephenson's valve gear to a Cliff and Bunting".

Alan Chapman with his almost complete Foden Compound Steam Wagon.

Peter Smith with his 4½" scale Allchin.

throughout New South Wales and Queensland".

After-dinner entertainment

After the tasty barbecue we were all invited to try out the bar at Paddy's Pub. The pub has not always enjoyed the tranquillity it enjoys today. Remote and silent as the surrounding bush was in the 1870s the road in front was always busy. The patient bullock teams plodding along, horse teams carting timber and wool, the drovers, miners coming and going to the diggings and Cobb & Co coaches with their cheery drivers. These were all part of the scene at Paddy's Pub in its heyday.

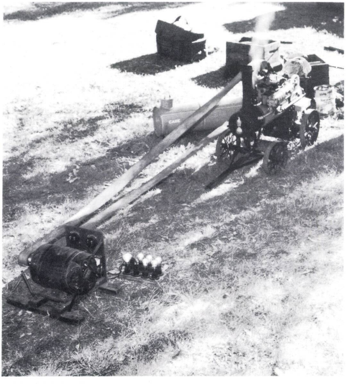
Not everyone took up the offer, but those who did relived the times when many nineteenth century folk sat and stood around the bar. The mood was electric as the publican, Pioneer Village President Les Parsons, and his offsider Andrew Fuller, led the party with old-time songs and humorous stories until closing time. It was one of the highlights of the weekend!

More of a good thing!

What do you do when you've had a fine day of traction engine driving? Have another one! Most people spent time swapping yarns

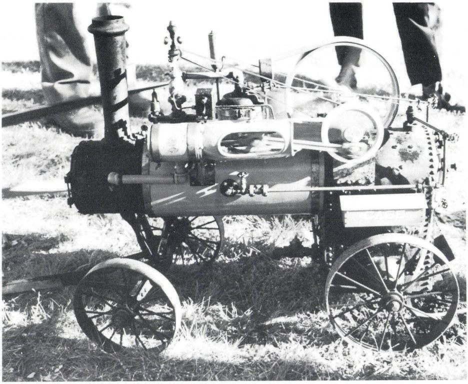
A traction engine rumbling across the picturesque lake and iron girder bridge. Perhaps a few model steam boats could ply the waters at the next rally?

- From an astute lady: "an organising committee of two men? Marvelous. They would have to get along with each other and make decisions".
- "That little *Case* portable has been generating 60 watts of power continuously now for two hours".
- "Yes, it took us ten hours to drive down from Bundaberg".
- "That *Allchin* of Jonesey's has inspired about ten other engines



Mark Mills' Case portable engine generating 60 watts of power to keep the globes alight over most of the weekend. It looked particularly good in the darkness of Saturday evening.

One of the highlights of the rally, Les (Pavarotti) Parsons, and his offsider Andrew (Carreras) Fuller, lead the singing and story telling in the historic Paddy's Pub



A closer look at Mark Mill's Case Portable engine.

Gordon Blake in front of the engines preparing to give the "off" for the grand parade.

and having a closer look at the Pioneer Village buildings as well as enjoying the engines and being "guest" drivers. There was a grand parade planned for later in the day.

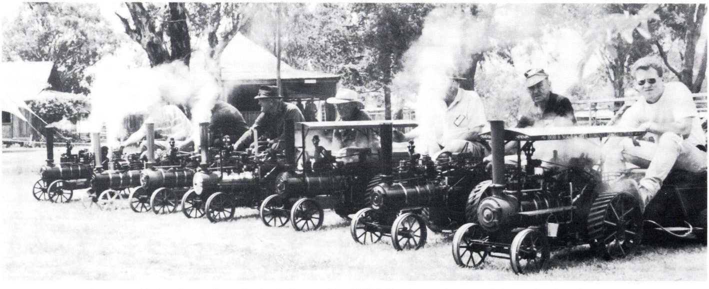
A fine way to remember Peter

Peter Bucknell was responsible for researching and publishing a construction series, partly in AME, of Australia's only traction engine manufacturing company — Cliff & Bunting. No less than eight 3" scale models of the Cliff & Bunting traction engine were present at Inverell. I think only five prototype engines were built! The model plans and castings are still available from Live Steam Supplies of Victoria. To our great saddness, Peter died about six weeks before this rally was held. As a tribute to him, our editor, Brian Carter, arranged a photograph of the Cliff & Bunting engineers and engines in a line-up. Unfortunately one engine and owner had to leave early and missed out. It was a grand sight to see the remaining seven lined up for the photos. Many other people recorded the line-up, there were plenty of shutters snapping and video cameras rolling.

Finally, the entire entourage gathered for the grand parade. All the engines lined up as though they were at the starting gate and champing at the bit. Then after much whistle blowing and safety valve popping — and the obligatory photo snapping and video taping — the engines moved off one-by-one as elephants in a parade. What a sight!

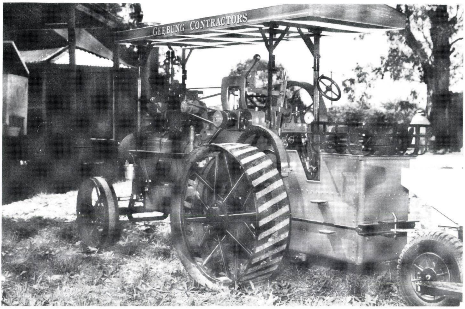
Thanks Gordon and Bob and your unnamed band of men and women helpers. We certainly know where Inverell is now! And we'll be back!

The 8th Traction Engine Rally will be held at Inverell again on 19 and 20 October 1996.

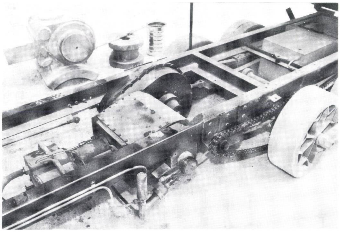


A steam whistle salute to Peter Bucknell. Seven of the Cliff & Bunting engines remaining on Sunday afternoon.
The engine owners from left to right: Victor Scicluna, Bill Heard, Gordon Blake, Andrew McLeod, Robert Henderson, Ray Schilling, Bob White.

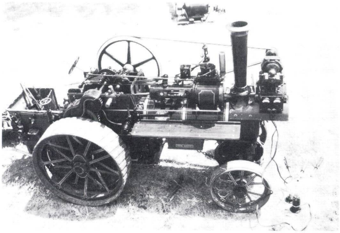
Ken Connon's Atkinson wagon.



The one that got away! Hugh Carseldine's Cliff and Bunting completes the eight.
Photo: John Snowden



A good reason to go to a rally in person — you get to have a good look under the hood! In this case it is under the tray of Chris Wilson's Sentinal wagon. The pattern in the top left corner is the cylinder block from his latest project — a 6" scale Savage centre engine. I hope it will be ready in time for the next visit to Inverell.



Not to be outdone by the Case, Col Jones' 3" scale Alchin hooks up to the dynamo to provide some illuminating discussion!

Left: *Rebecca Carter showing that not all of the engines were small! This Robey compound resides in the village as a static display.*

Above: *Gordon Blake took this photo as an invitation for you to fill in the missing persons. Join us again in 1996 and let's see you and/or your engine on this road around the village on 19 & 20 October!*

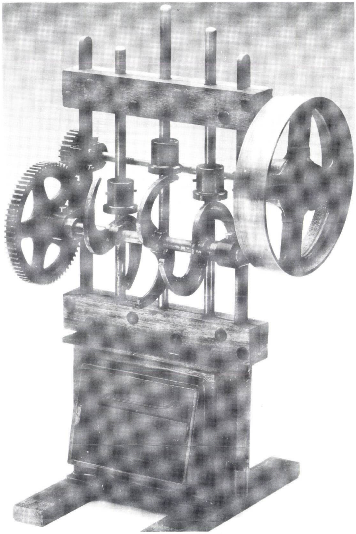
A 4" scale Stamper Battery

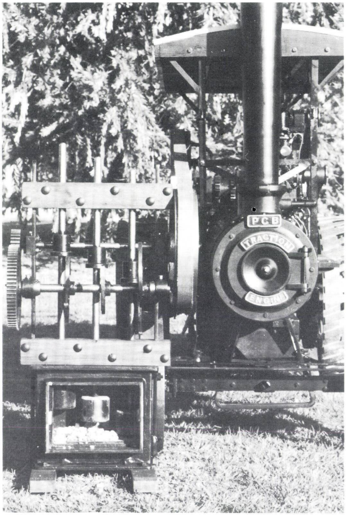
by Robert Jones

The incentive for building this model originated from John Snowden's article (AME, issue 37, page 34). The prototype John refers to is at the MSTEC, Scoresby. This unit is quite small, approximately five feet tall, and of simple design, making it easy to model. Living within five minutes from the prototype made it a simple task to measure the stamper and take tracings of the cams.

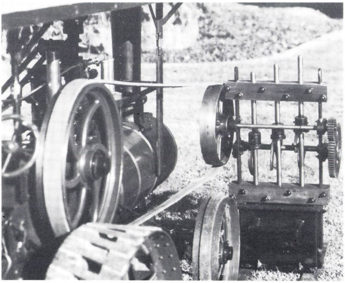
The model is built to 4" scale, allowing me to utilise various components from my scrap box like redundant lathe change wheels and a cast-iron trolley wheel as a flywheel. The stamper base is fabricated from ¼" MS plate and flat bar, 31 pieces in total, arc welded together. After I cleaned the slag from the welds, I filled the fillet radii by applying Ferropre® a plumbing two-pack epoxy putty to simulate the "as cast" appearance. The three lifting cams are also fabricated using ⅛" plate and ¼" square bar. Cams are attached to the shaft by gib keys as per the prototype. The stamper shafts are ½" BMS, heads 2" dia. x 1½" high, and the lifters are 1½"dia. secured to the shafts by taper pins. Both drive shafts run in plain bearings bolted to the vertical rails. Timber guide beams are 1½"x ¾" hardwood clamped together by ¼" coach bolts.

The model had its first run at the MSTEC labour day weekend rally, being driven by a small horizontal mill engine steamed from a full-size portable. Quartz gravel was on hand to prove to the tentative onlookers that it actually did work. Lashed up to the late Peter Bucknell's 3" Cliff and Bunting it showed that even though the scale was different, it was an interesting "accessory" to use with a traction or portable engine.





The late Peter Bucknell's 3" Cliff and Bunting working the Stamper. The front panel was left off to show the skeptics that it really worked!



A traction engineers' view of the stamper at work..

Maritime Matters

with Leigh Adams

Models and members assemble at Eddison Park, ACT.
Note the purpose-built trailers in the background.

ACT Regatta

Eddison Park was again the venue for the ACT Model Boat Club's Annual Regatta. Although overcast for most of the weekend, the rain stayed away which made the many visiting modellers happy to enjoy a weekend of cruising the pond and discussing the various 60 models on show.

Two of the outstanding models on display were Alan Fern's RN tender and John Affleck's model of HMAS *Hobart*.

Alan from HDMES displayed and ran his model powered by a single cylinder four-stroke petrol engine, radio controlled including an electric starter. This model moves very realistically through the water and the exhaust note adds to the atmosphere of true scale realism. Workmanship on all facets of this model shows a dedication to the hobby and his enthusiasm for setting a very high standard which we are seeing in more models in 1995.

John's high skills in detailed work is reflected in his model of HMAS *Hobart*, again workmanship and quality paint finishes give this scale model the edge. John prefers to work in brass and has developed some unique jigs and methods for cutting and assembling small components to represent the original items.

Both Alan and John's models are truly inspiring and after viewing can only encourage you to get back in the workshop and start building.

Another component to model boating is starting to grow and that is purpose built trailers for transporting models and sundry equipment to the regattas. Two trailers from Melbourne made the trip to Canberra displaying not only a large array of models but also some clever ideas for on-site creature comforts, such as fold-up chairs, tables, on-site shade havens and coffee making facilities. I can see plans for one of these being drawn up in the near future

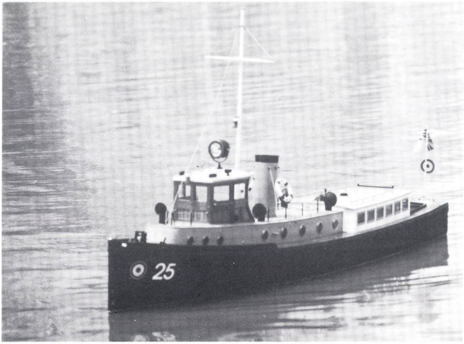
As in previous years the ACT Model Boat Club had organised another great event. President Peter Cole and his members I'm sure will continue to promote this event in 1996, so pencil it in on the calendar for next November and join modellers from around Australia.

Stolen models find their way home

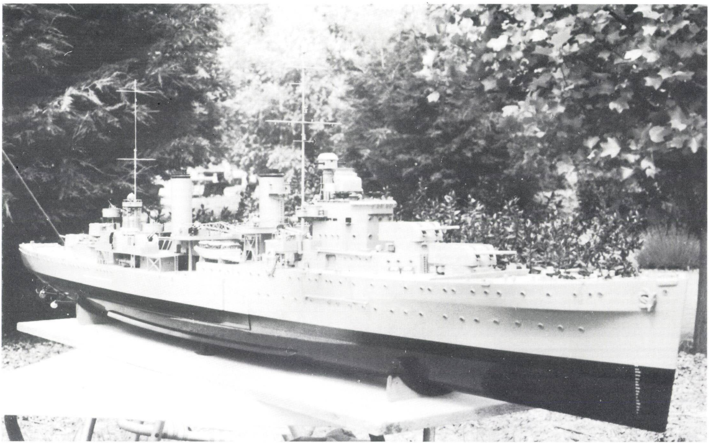
Sydney modeller Ron Adams has had some success. With the mystery that they were stolen, so were the circumstances with which they were returned. Anonymous phone calls started eight months after the theft, throwing suggestions that the models were in New Zealand and could be returned if some funding was forthcoming.

Then a late-night call informing us that to show good faith, one of the models was now ready for pick-up in an empty car park. Upon investigation: standing in the centre of a local car park stood the *Kanangra* complete and intact.

No further contact for a week or so until late one Sunday afternoon a phone call looking for the sting (money) for the return of the three models still at large. Calling the bluff, silence, and with a click of the handset the caller hung up, no further contact.

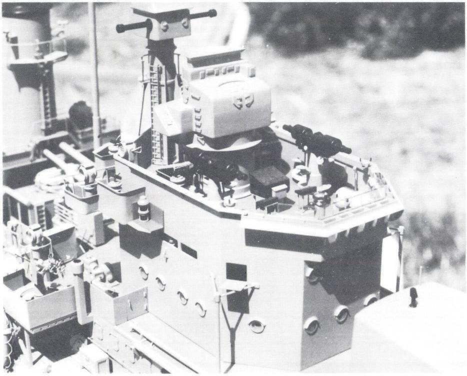


Alan Fern's RN Tender. This model is powered by a home-made four-stroke IC engine.



John Affleck's model of HMAS Hobart on display at Canberra '95.

Then a visit from a friend from some years ago announcing the rough whereabouts of the models and the possibility of their return. Again surrounded in mystery and stories of very unusual fabrication, and as with the smallest of information things started to move quickly and the same afternoon the *South Steyene* and *Lady Winifred* were delivered back, slightly damaged and very dirty, but basically intact. As with the great classics the motor cruiser *Mirus* is still missing and the police are continuing their enquiries.



A closer view of HMAS Hobart's bridge, John's attention to detail is outstanding!

Are You An Active Member?

Are you an Active Member?
The kind that would be missed,
Or are you just content
That your name is on the list?

Do you attend Club functions?
And mingle with the crowd,
Or would you rather stay at home
And complain both long and loud?

Do you give a little time
And help make things click,
Or leave the work to just a few
And whinge about the clique?

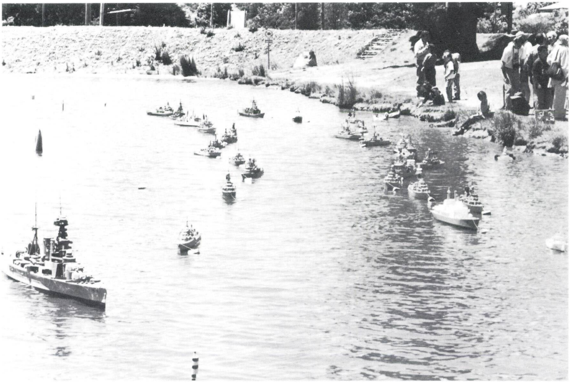
There's quite a programme scheduled
Which means success if done,
And it can be accomplished
With the help of everyone.

So think it over members —
Are you right or wrong?
Are you an Active Member?
Or do you just belong.

Task Force 72 Sails Into History

By Russ French and Allan Pew

Photos by David Mist



Task Force 72 at its Wentworth Falls anchorage.

Ships Diary Entry - 0900 hours Saturday 25th November, 1995 at anchor, weather - fine/clear 18 degrees, sea state 1, swell — nil.

The ships of Task Force 72 had started to gather at the "Midway" anchorage at Wentworth Falls Lake. The morning had seen a flurry of activity, erecting the large marquee, putting up fencing and placing the numerous buoys ready for the arrival of the task force ships.

It had been an early start for Russ French and Allan Pew, the commanders of Task Force 72. Russ had been up at 0545 to conduct a radio interview with Gary O'Callaghan of Sydney AM Radio 2UE. A quick breakfast and off to the office (Wentworth Falls lake). Defence Force recruiting personnel were there bright and early to set up their displays for the public and many volunteers arrived to help with the massive setting up process. Many of the almost sixty models began to arrive, they started taking their assigned anchorages ready for the day's activities.

The anchorage began to be transformed into an impressive sight as ships from pre World War 1 through to the new ANZAC class guided missile frigates and varying in size from the mighty battlecruiser HMS *Hood* down to six of the tiny Flower class Corvettes sat blissfully quiet swinging at their moorings.

This was the first opportunity of many members of Task Force 72 to get together and discuss their hobby, building techniques, problem areas, future constructions, members had come from as far away as Melbourne and Brisbane and gone to a great deal of trouble to transport their fragile models over such great distances without suffering any damage. The weekend regatta was to be the maiden voyage for many of the models, so the quiet morning (weather-wise) was a perfect opportunity to carry out a few sea trials and tests of the new models.

Much preparation was in hand for His Excellency Rear Admiral Peter Sinclair A.C. The Governor of New South Wales' visit. He and Mrs Sinclair arrived right on time at 1230. Met by the Commanding Officer and Naval Reserve Cadets of T.S. *Nepean.* The Couple was then welcomed by Russ, Allan, the many members of Task Force 72 and officials from the Penrith Sub-Branch of the Naval Association as hundreds of spectators looked on.

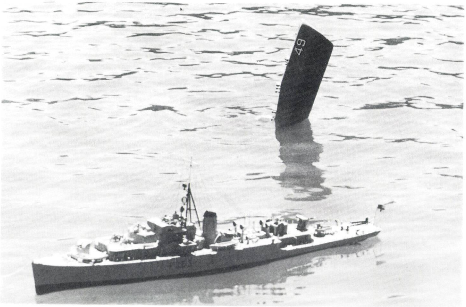
The Governor and Mrs Sinclair spent considerable time looking over the models before His Excellency was given temporary command of HMAS *Vampire* built by Wolfgang Nebart of Newcastle and then Lindsay Muxiows' HMAS *Swan* to which he was heard to comment on their surprisingly responsive handling.

Russ French greets Governor Peter Sinclair.

After a sumptuous barbecue lunch prepared by Dennis Walker, our expert chef and member of Task Force 72, the Governor and Mrs Sinclair were farewelled by all, including a Guard of Honour by the Naval Reserve Cadets. The only event to mar the visit was two unexpected tornadoes which ripped through the anchorage sinking or damaging several of the ships at their moorings, many others broke loose, but fortunately only minimal damage was done to any of the vessels and most of them were able to carry on their assigned tasks.

Saturday evening, as darkness approached, navigation lights were checked ready for the night-time exercises, about twelve vessels took part in the night run, manoeuvering between the green and red blinking navigation buoys with the flashing light of Ian Scott's magnificent lighthouse giving the scene more than just a touch of realism.

Russ, Allan and several others camped out that evening courtesy of the Defence Force Recruiting Tent, as security for the area. Allan secured the mighty *Hood* and she remained swinging at her mooring overnight. On waking at daybreak to find the lake shrouded in heavy fog, the temptation was too great for Allan and he had to take the *Hood* to sea in these conditions, unfortunately he didn't wake the rest of the security guard to share in the spectacle, so had the lake all to himself, a curious passing taxi driver being the only spectator. By 1000 the fleet had returned to the anchorage and not long after so had the fog which created a hive of activity among commanders, jostling each other in order to get their ships to sea and enjoy the spectacle of driving in and out of the fog with sirens wailing.



On of the casualties, going down stern first!

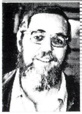
As on the previous day, our Guest of Honour this day Rear Admiral David Campbell AM RAN the Naval Support Commander and his wife Kaye were greeted by the Guard of Honour from the Naval Reserve Cadets presenting arms in salute. The Admiral was to take the salute from the fleet sail-past later in the afternoon, but before that it wasn't hard to persuade him to take command of a ship himself and he was offered the brand new ANZAC class frigate HMAS *Anzac*, built by Graham Pack of Sydney, unfortunately *Anzac* had electronic problems and broke down while the Admiral was in command so he transferred his flag to Russ' Adelaide class frigate HMAS *Adelaide*, in the meantime Lieutenant Commander Grant Dale, RAN as the Maritime Commander's representative had command of Russ' Anzac class frigate HMAS *Arunta*, Russ kept a close eye on both officers but no harm came to either vessel. Both officers remarked on how much fun could be had operating models such as these, two more possible recruits for Task Force 72. Following another superb barbecue lunch, the ships prepared for the "Fleet Review". Rear Admiral Campbell took his position on the jetty along with his wife Kaye, Lieutenant Commander Dale and other guests, as the ships started forming a line astern behind the largest in the fleet, Allan's HMS *Hood*. She was followed closely astern by HMS *Manchester* and HMAS *Vampire*. Other well know ships in the line were HMAS *Voyager*, HMAS *Adelaide*, HMAS *Brisbane*, HMAS *Swan*, two of the new ANZAC class frigates and three River class frigates, HMA ships, *Culgoa*, *Macquarie* and *Hawkesbury*. Almost 20 ships formed a reasonable line for the sail past which manoeuvered close to our guests where they obtained a superb view from above the ships. The line then formed a screen around the *Hood* and sailed out into open waters to attempt maneuvers as a complete unit, with surprisingly few incidents.

After the review, most of the ships returned to the anchorage, where their CO's took a well deserved break and chatted with the Admiral until his departure at 1500. All CO's were then presented with personalised certificates especially printed for the inaugural Task Force 72 gathering and Fleet Review, with the new Task Force 72 motto "Quis Habes Crepundia Maxime Victor" (He who dies with the most toys, wins) and we're sure most members went home from a fantastic weekend with their heads buzzing with plans for their next toy.

It was agreed by all that this Regatta should become an annual event, so keep an eye out for more details as they come to hand and don't miss it!

Alan Pew's HMS ***Hood*** *ready for action.*

Steam Chest



with Dave Harper

A final note on the Umberumberka/Spotswood pumping engines. In the previous issue of AME, the Spotswood engines were referred to as locally built copies of the British Hawthorn Davey units; it should have been "Hathorn Davey". Incidentally, one of the volunteers from Spotswood phoned me recently and told me that there were in fact five pumping engines at Spotswood. Whether one of them is Austral Otis' own design I'm not sure. Reading the information sheet from the Scienceworks leads me to think that they are all Hathorn Davey copies. Can anyone confirm this?

It's a small world!

One of my regular correspondents — Dave Sampson of Brisbane — wrote to me recently, and as a result we've had a couple of most enjoyable days together. I've also got material to keep this column going for ages!

Dave told me that he had made a number of small model feedwater pumps among other things; was I interested? Of course I was, and I spent a happy day at Dave's place photographing the most amazing collection of steam models I've yet seen.

Photo 1.

Dave is a retired marine engineer. Over the last 30 years or so, he has built up a collection of models in which he has tried out all the variations in valve gear and pump types he could find. I ended up taking over 40 photos, and didn't really do the collection justice!

A week or so later, I brought Dave over to my place so we could go through the photos and note the details on each of them. We also compared libraries — we'll be doing some book borrowing shortly!

One of the first things Dave mentioned was the big Corliss valved ammonia compressor mentioned in last issue. It turned out that Dave had actually operated this machine about 1970, just before it was removed from the Metropolitan Public Abattoir in Brisbane!

What's more, he had dug out a data sheet on the engine that was given out to visitors to the abattoir. Naturally, I smartly had some copies made. Here is some of the information on it.

It's called the Ball Giant Compressor and was made by the Ice and Cold Machine Company of St Louis, Montana, USA about 1912. It worked at the abattoir from 1914 till 1967.

The bores are 18" and 42" by 42" stroke. The common crankshaft drives two cylinder horizontal compressors of 18½" bore and 42" stroke. It ran at 64rpm.

The notes read on: Before the days of low freezing temperatures and two-stage compression, the Ball Ice Machine was used for both freezing and chilling by isolating the double-acting cylinders using two suction pressures in the order of 2 lbs gauge on the head of the piston for freezing and 20-24 pounds gauge on the stuffing box end of the cylinder for chilling.

Now you're as wise as I am...

The notes also claim that the machines had run for twelve months without stopping on several occasions. Dave doubted that very much as apparently the stuffing boxes needed repacking about every month!

The Sampson collection

Photo 1 shows Dave getting as near as I could get him to cracking a smile. Being a Yorkshireman with a dry sense of humour this wasn't easy! He is holding one of his larger models, the details of which he copied from a book in Liverpool (UK) reference library in the 1960s. It was called a portable engine, and was built in the 1820s.

Photo 2 shows the engine in close-up; **photo 3** is an even closer view of the governor. The end frames were cut and filed from ¼" steel plate and the flywheel fabricated from ⅜" plate! Note the "pitchfork" connecting rod and eccentric driven feed pump. The proportions of the governor were taken from that on the Ball Giant Ice Machine! Dave has had trouble finding a drive belt that will stand whirring around all the small pullies to drive the governor. Anyone got any suggestions?

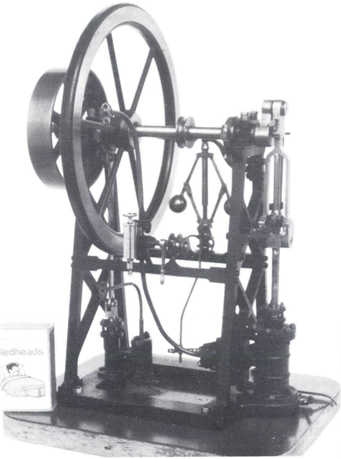


Photo 2.

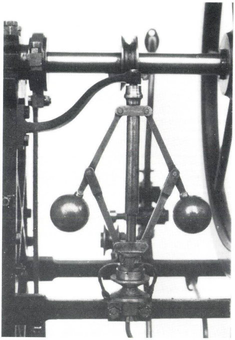


Photo 3.

Photo 4 shows one of Dave's recent jobs, an exquisite little Banjo Pump. I used the matchbox in most of the photos to give an idea of scale. These shots really gave my macro lens a workout!

Photo 5 shows a pretty close approach to steam watch-making! It is a compound marine engine with surface condenser and four pumps — bilge, feed, air and circulating water. It also has a steam reversing engine operating the Stephenson valve gear. Bores are 7/16" and 5/8" by 1/2" stroke.

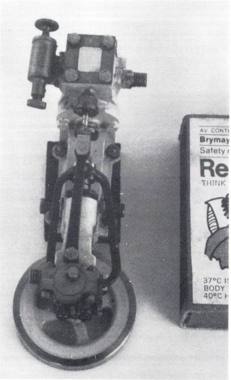


Photo 4.

The condenser was made from a piece of full size condenser tube formed to rectangular shape, and contains ten 1/8" tubes!

The last photo this time around shows a diminutive Scotch boiler complete with Simplex pump and feedwater heater. The latter is the horizontal tube above the pump, consisting of two concentric tubes. Exhaust steam passes through the outer one, feedwater through the inner.

Dave actually fired this boiler up on my visit, using a butane gas burner, and ran one of his other engines, which I'll tell you all about another time!

Marine crossheads and all that

As promised last time, I've dug up some info on marine crossheads which just about exhausts that subject — I think!

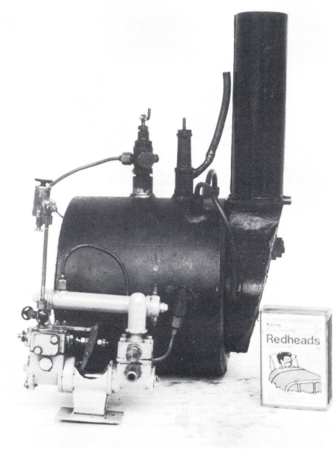


Photo 6.

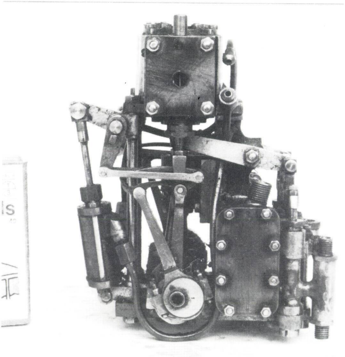


Photo 5.

I found this information in a recently acquired gem called *Heat Engines* by William Ripper. My copy is the umpteenth edition, published in 1927, of Ripper's *Elementary Steam* — first published in 1889! Since 1909 the volume has included chapters on steam turbines and internal combustion engines and so is now called *Heat Engines*. See?

Ripper's section on crossheads and guide blocks is so complete and concise that I am copying it in full:

"The crosshead forms a head at the outer end of the piston rod, to which the connecting rod is attached by a pin passing through the crosshead. It varies very considerably in design. Guide blocks are sometimes attached to each end of the pin, on either side of the crosshead, as in **fig 1**. Another arrangement is to make a foot solid with the crosshead, which acts as a guide block, and works between guides, as shown in **fig 2**.

The blocks and guides prevent the

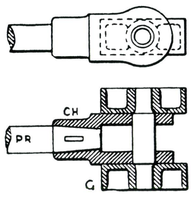


Fig 1

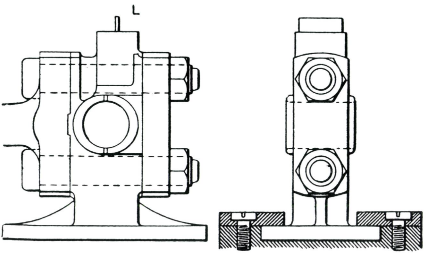


Fig 2

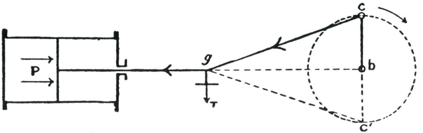


Fig 3

oblique thrust or pull of the connecting rod from bending the piston rod. This can be seen by reference to **fig 3**. When the piston P is being impelled forward, so that the rotation of the crankpin is in the direction of the arrow, the resistance at the crank pin c causes a downward thrust through the connecting rod cg, which may be resolved into two forces, one tending to compress the piston rod and the other to bend it in the direction T, causing a downward thrust upon the guides. Again, when the piston is being driven back by the steam, the resistance of the crank pin at c causes a downward pull at the point g of the piston rod, the tendency again being to cause a downward thrust upon the guides. If the engines were reversed the whole of the conditions would be reversed and the thrust gT would be upwards instead of downwards. Hence the prevailing direction in which horizontal engines should run is that shown by the arrow in the figure, so that the pressure on the guides should be upon the lower rather than the upper guide bar; this is especially important for the sake of efficient lubrication.

It should be noticed that when the crank pin drags the piston — as it does, for example, when steam is shut off while the engine continues to rotate — the direction of the thrust on the guides is reversed; hence the necessity for a top and bottom guide bar under all circumstances. The amount of the thrust on the guide varies according to the angularity of the connecting rod, being greatest when the crank is at right angles to the axis of the piston rod, and being reduced to nothing at each end of the stroke; hence the guides wear hollow in the middle, and arrangements should exist for removing the guides and truing them up.

The amount of thrust on the guides in the middle of the stroke can be found from the following simple formula:

Maximum thrust = pressure on piston x radius of crank in inches divided by length of connecting rod in inches.

Example: Find the maximum thrust on the guides when pressure on piston at half-stroke = 20,000lbs; radius of crank = 15ins; length of connecting rod = 5ft.

Maximum thrust = 20,000 x 15 divided by 60 = 5,000 lbs.

When engines are required to rotate in either direction equally, as in the locomotive, the surfaces in contact between the block and the guide are made equally large, as is the case in **fig 4**, with the top and bottom guide bar; but when the engine is intended to rotate always in one direction, or nearly so, as in the marine engine and in factory engines, the surface on which the thrust comes is made sufficiently large, while the opposite surface may be much reduced, as is the case with the slipper or shoe guide (fig 2), the prevailing direction of the thrust being taken on the largest surface of the block."

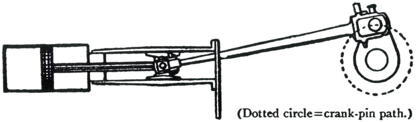
I think that sums up the subject of crossheads completely, don't you?

Where to from here? Well, I recently had the privilege of borrowing an amazing old book called *Modern Marine Engineering* by N. P. Burgh, published in 1872.

This book gives a snapshot of a period when marine engines were being designed in all sorts of bizarre styles, like trunk engines, double piston rod, return crankshaft engines, and so on. By 1890 the triple expansion engine had rendered all these monstrosities obsolete, and by 1900 they had disappeared. Therefore, this is an important work: it illustrates in considerable detail types of engine that are now completely unknown.

I was fortunate enough to be able to photocopy a major portion of the book, and I propose to work through some of the remarkable engines of the period using this material. To some it may suggest ideas for modelling. To me it mostly says that the early marine engineers must have had a nightmare existence! Still, it all adds to our knowledge of steam engines, and that's what this column is all about!

Happy steaming!



(Dotted circle=crank-pin path.)

Fig 4

Testing Pressure Gauges

by Jon Milne-Fowler

Drawing for publication by Rex Swensen, photos by Stephen Alfrich

At the initial testing of miniature boilers and at subsequent inspections, the pressure gauges fitted should be seen to function satisfactorily and the boiler inspector must be satisfied that the gauge is reasonably accurate at the working pressure of the boiler.

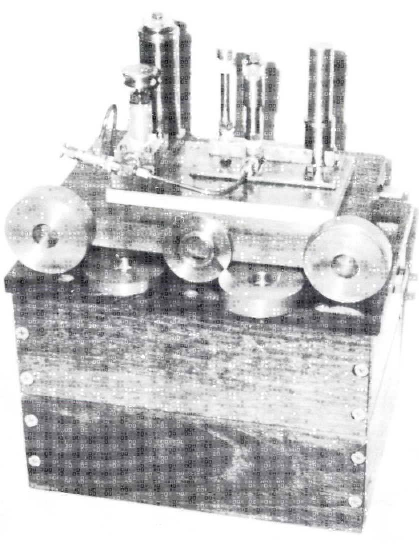
Various methods of testing pressure gauges have been described from time to time, usually involving comparison with a master gauge of known accuracy.

Dead-weight testing

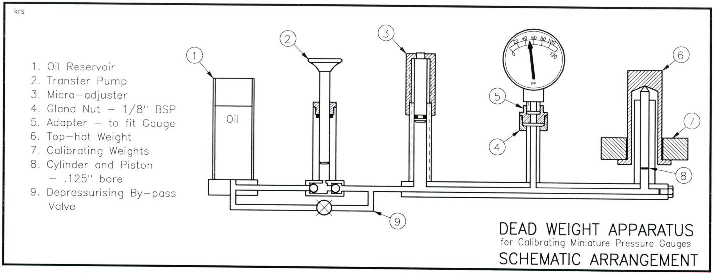
The most accurate method of testing is by the use of a dead-weight pressure testing apparatus. This apparatus is perhaps regarded by the uninitiated as an expensive piece of laboratory equipment which must be made to exacting standards beyond the capability of the average model engineer with limited workshop machinery. My apparatus was inspired by the series described by Kozo Hiraoka and published by *Live Steam* in 1986. It was a design for small dead-weight apparatus intended for calibrating a miniature pressure gauge.

My design departs from Kozo's description in several important aspects.

1. The *Live steam* description was for a simple set up only suitable for calibrating/testing a very small gauge with a case 25 mm outside diameter and a correspondingly small volume bourdon tube. Its plunger was 3 mm diameter and the set of weights was designed for calibrating a gauge from 0 - 10 kg/cm^2 and the set was so specified that 2 kg/cm^2 and 9 kg/cm^2 required interpolation on the scale.
2. My unit utilises a calibrating piston (plunger) ⅛" diameter and the set of weights specified gives 10 psi steps for



The dead-weight apparatus, complete with its own wooden case.



calibrating gauges through the range 0 - 160 psi.

3. My unit incorporates a micro-adjuster for use with gauges requiring slightly more volumetric displacement than is available with the travel of the ⅛" diameter calibrating piston.
4. My unit incorporates a transfer pump for the use with gauges requiring a greater volume of displacement than can be obtained with the calibrating piston and micro-adjuster combined.

Metric or imperial

The testing apparatus was made with adherence to very close tolerances, using basic workshop facilities and two old sets of kitchen scales, a 40 year old beam balance type graduated in quarter ounce divisions, and a 60 years old type that was once common in grocers shops and farm kitchens. It was supplied with a set of cast iron weights ranging from one ounce to four pounds. Kozo Hiraoka's design called for a pressurising plunger 3mm diameter and a set of weights ranging from 71 grams (including the plunger) to 283 grams, totalling 707 grams to generate a pressure range of 0 - $10 kg/cm^2$.

I was confronted with two situations: firstly, most of the gauges that I want to test for accuracy are calibrated in the old imperial system of pounds per square inch; secondly, I do not possess a set of gram scales.

On checking the materials I had on hand I found some ⅛" dia. stainless steel rod, which was spot-on for size when miked, that became the starting point for calculations. The weight required to generate a required pressure in a gravity dependent hydraulic system may be determined by reference to the formula $W = A \times P$, where A is the cross sectional area of the plunger in calibration units and P is the required pressure in units of force. So a 1lb weight will be required to generate 10 pounds per square inch pressure if the plunger has a cross sectional area of $\frac{1}{10}$ square inch. Using a plunger of ⅛" dia. the weight in ounces required to generate 100 psi. then becomes:

$$W = \frac{11}{14} \times \frac{1}{8} \times \frac{1}{8} \times \frac{1600}{1}$$

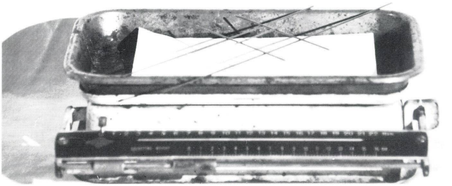
$$= 19\frac{9}{14}\text{oz.}$$

and for 10 psi $W = 1\frac{27}{28}$oz.

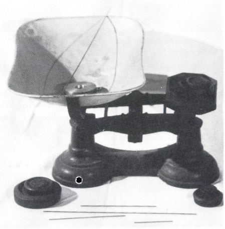
Fractions of an ounce like this do not lend themselves to the once common halves and quarter ounces used in post offices for letter balance sets, even if such a set was available.

The solution was to use stock 1.6 mm Tobin bronze brazing rods. Ten of these rods weighed on the beam balance scales registered $5\frac{1}{2}$ oz. so one rod was equal to 0.55 oz. The length of these rods was 902 mm so half an ounce would require a length of 820 mm and one ounce would amount to a length of 1640 mm. A weight of $\frac{1}{28}$ of an ounce would therefore be 58.57 mm. The lengths of rod were cut to correspond to $\frac{1}{28}$ oz., $\frac{2}{28}$ oz. (two off), $\frac{4}{28}$ oz and $\frac{5}{28}$ oz. The shorter lengths were checked with vernier callipers, while the length of the two longer pieces were compared with the combined lengths of the shorter pieces. When these were check weighed on the beam balances they registered a total of ½ ounce. By combining these crude fractional ounce weights with the ounce weights in the old cast iron set it was possible to check-weigh the weights for the dead-weight tester as they were machined, and to calculate what further cut was needed to arrive at the required weights to make the set. On completion of the machining, a visit to the local high school provided access to a set of electronic laboratory scales with the following results.

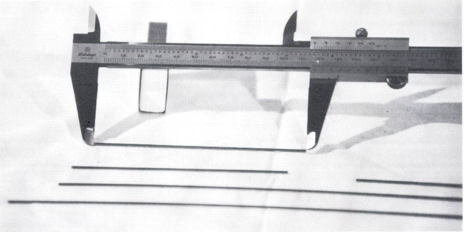
As can be seen in the tabulated results below, weight No 3 was 2.65 grams light and each of the others were within close tolerance of the calculated requirement. The variance with No 3 must be attributed more to machining error than to the weighing equipment used in the workshop, it was known to be approxi-



Check weighing the set of $\frac{1}{28}$ oz weights, the five rods total ½ oz.



The No. 5 weight being checked. $9\frac{23}{28}$ oz or as seen, the weight plus $\frac{5}{28}$ oz equals 10 oz



Checking the length of a $\frac{2}{28}$ oz weight cut from a brazing rod. The reading is 107.14mm.

Weight	Calculated Requirement Imperial (oz)	Metric (gms)	Actual when checked +	-	grams
1 for 10 psi	1 off $\frac{27}{28}$	55.7	0.65	0	56.35 gms
2 for 20 psi	3 off $\frac{26}{28}$	111.4	0	0.45	110.95
3 for 30 psi	5 off $\frac{25}{28}$	167.0	0	2.65	164.35
4 for 40 psi	7 off $\frac{24}{28}$	222.7	0.28	0	222.98
5 for 50 psi	9 off $\frac{23}{28}$	278.4	0	0.17	278.23
Total 150 psi		835.2			833.00*

*This was the actual figure displayed on the electronic machine when all weights were checked together.

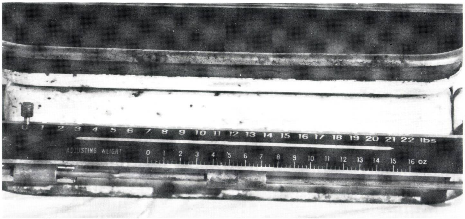
mately 2⁄28 of an ounce lighter than intended but no attempt was made to correct it until the set had been checked on more sensitive equipment. No 3 weight could be modified by brazing a ring of Tobin bronze to its periphery and then making final adjustment by judicious filing.

The greatest error which the unmodified set of weights would be liable to produce in their various combinations is plus 0.93 grams or 0.17 lbs/square inch less than theoretically correct, and 3.27 grams or 0.59 lbs/square inch more than theoretically correct. The types of pressure gauge with which we are concerned are generally not capable of being read within an accuracy of better than two or three pounds per square inch, often with the smaller gauges a reading discrimination of 5lbs/square inch is the closest you can hope for.

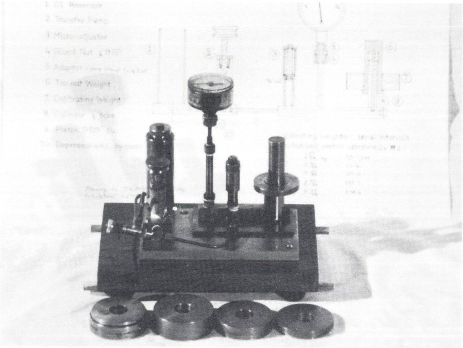
Acceptable tolerance

We are not aiming for National Physics Laboratory standards of accuracy. Once satisfied that the weights were within acceptable limits of tolerance for their purpose, attention was turned to the rest of the apparatus. The original design was intended for calibrating a gauge only 1" diameter with a correspondingly small volume bourdon tube. However, I realised that for the test rig to be useful for testing larger gauges, provision would be needed for boosting the volume of hydraulic fluid actuating the gauge under test when necessary. This was achieved by providing a thumb operated pressure pump with a 3⁄16" diameter piston, drawing its supply from a reservoir 1" diameter and 2½" high. In addition a micro-adjustment has been provided in the form of a small cylinder with ¼" diameter piston operated by a screwed thimble, threaded 40 tpi.

Fluid which has been pumped into the pressure system returns to the reservoir when a by-pass valve is opened.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 lbs
ADJUSTING WEIGHT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 oz

Showing a 5½ oz reading for 10 lengths of tobin bronze.



The apparatus set-up with a pressure gauge mounted for calibration testing.

The AMBSC Boiler Inspectors kit, with the cased testing apparatus on the right.

Conclusion

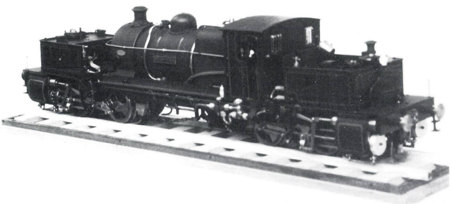
I must emphasise that this apparatus is not intended to achieve the standards of accuracy attainable with a Standards Laboratory set of equipment. It is intended to meet a practical requirement to field test pressure gauges and establish that they are functioning within acceptable limits, particularly at their working pressure.

Readings should be taken up and down, both to compensate for possible friction errors in the equipment and for checking correct functioning of the gauge under test.

I would not advocate attempting to capture and re-cycle the inevitable small amounts of oil which will seep or be spilled while using the rig. It will certainly be contaminated with dirt and dust which are unavoidable companions during field testing. I keep an old cotton rag handy to wipe up when necessary.

Garratt Gossip

with John Cummings



***William Francis**, a 2½" gauge 0-4-0 + 0-4-0 British colliery locomotive.*

Although we got good response when we originally asked to hear from Garratt builders, it's surprising how many other people are coming out of the "metal work".

Since the May/June 1995 issue I have had two phone calls. One was from a builder in NSW who is well under way with construction of two Australian Standard Garratts in 7¼" gauge. He is using a scale of 2" to 1ft, which will make it a fair-size loco.

The other caller, from Sydney, is building a freelance Garratt in 5" gauge. The loco is based loosely on the *Blowfly* 0-4-0 doubled up. It will have outside slide valves operated through rockers from the eccentrics between the frames.

Correspondence

AME is getting a wider international reputation! I received three letters about Garratts, one from New Zealand and two from the UK.

From a New Zealand reader. He has started construction of a Tasmanian K class Garratt in 5" gauge. He is also interested in the Darjeeling Garratt: if any reader has some information on the Darjeeling Garratt, please pass it on to me and I will send it to him. He told me that the original K class, which was sold back to Beyer Peacock in the 1950s, has now been removed from the York National Railway Museum for a complete overhaul. It will be returned to service for the re-opening of the Welsh Highland Railway between Porthmadog and Caernarfon.

From the UK, Peter Graham Wardle writes:

" I have been handed a copy of your magazine dated July/August 1993 (issue 49) by a friend. The front cover depicts one of the most attractive models I have ever seen of a Beyer-Garratt. The maker is certainly to be congratulated. Why do I say these things? ah yes - I am an ex-Beyer Peacock apprentice. Just as a sideline I too make model Garratts — photos enclosed of my efforts — but my engines are 2½" gauge. Anyone who cares to drop me a line would be welcome. I have a few drawings of my own models which may help somewhere along the line. Incidentally, the models in the photos are a 4-8-4 + 4-8-4 Kenya Uganda Class 57 - No. 80 *Narok*, and *William Francis*, an 0-4-0 + 0-4-0 British colliery locomotive."

Peter continued, "In a separate letter I have ordered *The 60 Class* book *(no longer available and now out of print... ed)*. My job on that engine, while I was an apprentice, was to make the water sieve baskets for the water tanks!!"

He concluded, "I hope this letter may result in at least keeping *Garratt* modelmakers from thinking they are lonely engineers on an impossible quest — there are at least 12 such people in the UK! I am investigating the possibility of a Beyer Garratt Model builders/owners club in UK."

Mr. B. B. Brookes from the UK writes. "Having got myself three AMEs at the Midlands exhibition, I found you are, (or have) putting together a Garratt pool. I am building a NSW AD60. The two engines are complete and tested and the boiler is complete. So you may think, what do I need to know? Well, about reversers, brakes, steam pipes — and a whole lot more! I am building in 5" gauge and the loco is just under twelve feet long.

I have a full set of plans for the East African Railways 60 class which I acquired three years after starting the AD60 project. I have visited Australia five times, the last was in 1992, when I met Bob Brown of Adelaide. I would love to hear from other NSW AD60 class builders."

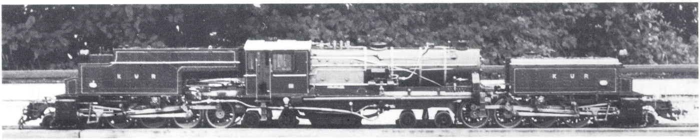
Expansion joint drawing correction

A reader pointed out a mistake in the May/June 1995 issue at page 48. On the drawing of the exhaust steam expansion and ball joints, the ¾" diameter bronze ball is *not* silver soldered to the ½" diameter copper pipe but to the exhaust slider.

A new Garratt

A Garratt nearing completion is Ted Macintosh's 7¼" gauge 0-4-0 + 0-4-0 freelance. The loco was subcontracted for construction in three sections: the engine units, the boiler, and the boiler fittings. The final assembly and trial is being supervised by Joe Sutton. The loco has had a few trial runs, but needs a bit more work to call it finished.

Some of the statistics may be of interest to prospective Garratt builders. The engine units were built up from two Reeves *Hercules* 0-4-



A 2½" gauge 4-8-4 + 4-8-4 Kenya Uganda Class 57 - No. 80 ***Narok.***

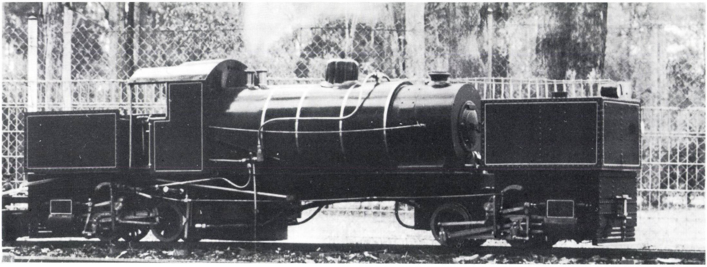
0 chassis kits. The driving wheels are 162mm diameter. The cylinders have a 54mm bore and a 82.55mm stroke. The boiler is a 324mm outside diameter steel shell with a working pressure of 960kPa. The boiler is fitted with a five-element superheater. The throttle is a Klinger® type, fitted in the smokebox. The steam is supplied to the engine units via a Radcoflex® stainless steel high pressure flexible hose. The locomotive is about 2.13 metres long overall.

If any reader wishes to contact our correspondents drop me a line care of AME and I will pass along the information.

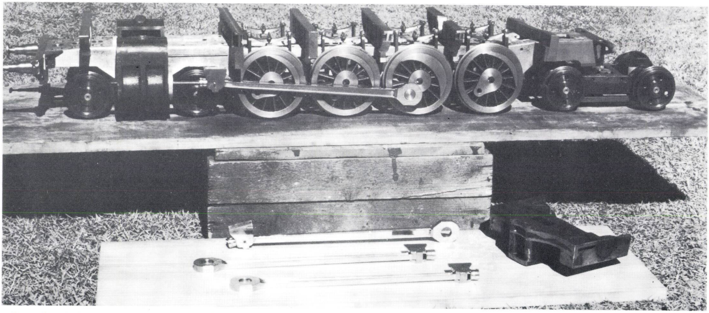
Where would we be without all those challenges? And almost double the number if you own a Garratt!

All correspondence for this column to:
Garratt Gossip
C/o AME
PO Box 136
Robertson, NSW, 2577

Joe Sutton eases Ted Macintosh's 7¼" gauge freelance 0-4-0 + 0-4-0 Garratt out of the station at the Western Districts Live Steamers' grounds, Failfield, NSW.



A closer view of Ted's Garratt.



Since the 60 class was mentioned, I thought I'd share this photo with you. It is one of the engine units for Warren Starr's AD60. I think the most novel feature of Warren's Garratt is the use of stainless steel for all the rods!

③ Mill Vice T-slot Guide

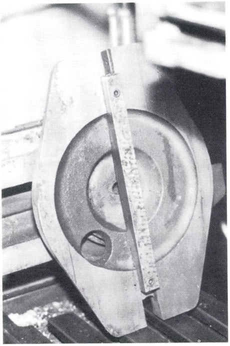
Shop Hints of Peter Dawes

All milling vices and dividing heads for the milling machine should have guide bars screwed into their base to provide quick location and alignment in the T-slots. It is not worth adding guide bars to low-quality vices. Indeed such vices are an abomination and should be discarded.

This idea for adding guide bars is intended for so-called precision or engineers machine vices that have ground surfaces. It is an improvement that is an investment for the future. The longer you have it and use it, the greater the return.

1. Obtain a piece of heavy angle about 300mm or more long, 75mm x 75mm x 12mm or so. Clean up the surfaces on the linisher and with a file to make sure they are flat, and clean enough on one face for a dial indicator.
2. Obtain a piece of BMS bar stock say 16mm (⅝") square to fit the table slots. Cut it to a length about 20mm less than the distance between the vice mounting holes on each side of the base of the vice.

   This is because the bar will interfere with the T-slot nuts if it comes any closer to the hole. If there is any obstruction in the centre of the base, you will have to find a way around or over it, or cut the bar into two pieces putting two cap screws into each piece.
3. Drill two holes in the bar for M6 or ¼"BSW cap screws, one at each end at places which are suitable for drilling into the base. Counterbore for the heads because they will be a nuisance if they project when the vice is being stored on a shelf.



4. If it is a rotatable vice, set the scale exactly to zero.
5. Clamp the best face of the angle tight in the vice jaws true to their top face and turn the whole thing upside down on the table. Clamp the angle to the table at both ends so that it is exactly parallel to the table slots — to dial gauge accuracy. Make sure the top surface is reasonably parallel to the table surface. This plane is not critical.
6. Mill a 16mm (⅝") slot, 3mm (⅛") deep, across the width of the base of the vice along the line that joins the two mounting holes using a big slot drill. This assumes that the slot is for a 16mm (⅝" wide bar. If your slots are different choose a width that is appropriate.

   Use a slot drill because an endmill may cut too wide for stock-size BMS bar. Either that or use a smaller diameter cutter and widen the cut out to suit. Either way, the slot should be a light hammer fit for the bar.
7. While it is upside down, drill and tap the holes in the vice base for the bar, locating them from those in the bar itself.
8. Turn it back over and test it out.
9. Dividing heads should be similarly adapted. Don't forget the tailstock if there is one. The method of holding the device upside down will necessarily vary.

   The rotary table doesn't need a locating bar but if it doubles as a dividing head when it turns up vertically, then it does need one on the foot, and one that lines it up accurately with the tailstock. To mill the slot for this on mine, I turned it over and bolted the bottom face to a big angle plate. Aligning this is simply a tedious job with the dial gauge.
10. To store and support the vice on a shelf, cut a piece of particle board and rout or saw a slot in it in the appropriate place, and of such width and depth to accommodate the bar comfortably. The front of the vice can overhang the base by many inches if it has an add-on rotating base, so add a block across the front of the board to stop any potential tipping. On my Hafco 6" vice it isn't a safety issue so much as just making it more stable.

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AUSTRALIA.

Fabricating Spoked Railway Wheels

Producing accurate Spoked wheels in 1/12th scale

by Bob Brown

Drawings for publication by David Mottram

I would like to share my method of fabricating three feet diameter wagon wheels. When produced at one-twelfth scale, they have a nominal tread diameter of 3" (75 mm) and an overall width of ⅝" (16mm). When planning to make them, you need to allow for the outside diameter over the flange, the number of spokes required.

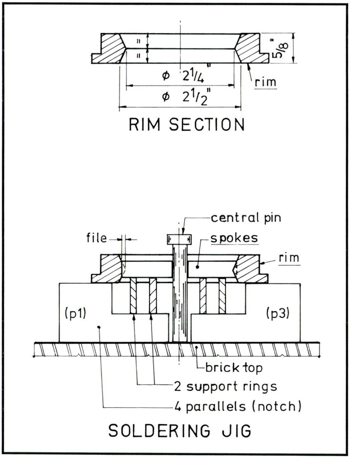
Material required

- Steel hollow bar for the rim (inside and outside diameter suitable to allow machining of the tread and the landing for the spokes, nominally 2¼" (56mm).
- Flat bar for the spokes: ⅜" x ⅛" (10mm by 3mm). The black steel variety has rounded edges which provides a neat bull-nose edge to the spokes.
- Round steel bar for the hub.
- Silver solder and heating equipment.

Procedure

1. Rough-turn the hollow bar to approximately the inside and outside diameters of the rim. Leave sufficient metal for final machining to size.
2. Part off the required number of blanks.
3. Finish-machine the inside diameters of the blanks, providing a double taper as shown in the sketch.
4. Cut the spoke material to a nominal length of 1⅛" (29mm). Ensure that the ends are square.
5. Mark the inside diameter of the rim with the location of each spoke.
6. Either file or machine slots about 1/16" (1.6mm) deep for the spokes, across the vee section of the rim.
7. Arrange a jig to facilitate silver soldering of the spokes to the rim. The sketch shows a suitable method which provides good airflow around the components. The central pin is merely to anchor the spokes while soldering.
8. Silver solder the spokes in position. A neat job here, with a good supply of heat, will reduce the work involved in finishing.
9. Boil the assembly in water to remove the flux (*or you could drop the hot assembly in water to "boil off" the flux... ed*).
10. Set up the assembly in the lathe, and with light feed and care, bore the spokes to accept the hub. I find that a two degree taper on the bore and on the outside diameter of the hub is effective.
11. Machine the hub to suit the completed bore.
12. Using the jig once more, silver solder the hub to the spokes.
13. Boil the assembly in water to remove the flux (*or you could drop the hot assembly in water... ed*).
14. Finish-machine the completed assembly

There you have it! Nothing makes a carriage look more elegant than scale spoked wheelsets!



South African Steam for New Zealand?

Following on from John Wakefield's article on his 5" gauge South African class 16F locomotive, which he runs (mostly) in South Australia, Ian Welch of New Zealand's Mainline Steam Trust — operators of Ja and Ka steam locomotives, among other activities — has purchased four ex-South African Railways steam locomotives!

The big ones!

- class 24 2-8-4 No.3620 built by North British Locomotive Company, No.26333, 1949;
- class 25NC 4-8-4 No.3432 built by Henschel & Sohn, No.28751, 1954.
- class 25NC 4-8-4 No.3508 built NBL No.27368, 1954
- class GMAM 4-8-2+2-8-4 Garratt (not yet specified)

Ian's intention is to import them into New Zealand and run them in locations where their large dimensions and weights can be accommodated. The glamour among them would be the class 25NC 4-8-4s.

They measure in at 91½ feet long with a tractive effort (TE) of 48,000 lbs. The GMAM garratt is 94 feet long and has a TE of 64,000 lbs (against the NSW AD-60s of 63,000 lbs). Even the "diminutive" class 24 2-8-4 is impressive at 75 feet long and TE of 29,500 lbs (against the NZR Ka 70 feet and 31,000 lbs respectively).

A shorter route to South African steam

If this plan comes to fruition, the potential for the Mainline Steam Trust would be enormous, especially from the Aussie side of the ditch, from which there would be many pilgrimages to see the best of South Africa steam in action!

Power for your Points

Signal cabin control of air operated points linked to colour light signals

Part 2 - Signal and Electrical Components

by Tom Hulse; photos and drawings by the author

Nothing quite beats the atmosphere of a night run, steaming away from the bright lights of the station and into the darkness to the furthest extremes of the track. A darkness speckled with red, amber and green pinpoints of the signals which link you to the reality of the distant signal box and the train up ahead.

In Part 1 of this article, the mechanical construction of an electro-pneumatic point was described. In this article we cover the electrical part, together with the signals that control access through the turnouts. The Figure numbering continues in Part 2.

Operating the panel

With the mimic panel as shown on this page in front of you, let's go through its operation. Concentrate on that track mimicked on the right-hand half, as the left-hand half is another part of the track and will be explained in a moment.

The point electrical switch at the bottom is centre off; momentarily operate *up* to set the points to branch and momentarily operate *down* to set the points to main. Only a second or two operation before returning to centre is all that is necessary to allow a puff of air to swing the point over. LEDs BI and MI, which receive a voltage back from the point microswitches, light in turn and confirm which way the point is set. Note if neither BI or MI is lit, the point is probably jammed with leaves or twigs. Now the point will only change if both main and branch signals are set to red. To get both signals red, the signals switch must be set to centre off. The signals are mimicked by the panel LEDs BR (Branch Red) BG (Branch Green) MR (Main Red) and MG (Main Green).

Once the points have been set, you then set the corresponding signal green by throwing the signal switch, which is double throw, centre off. If you have set the points to main, note that only the main signal can be set to green.

OK so far? Just a bit more operation than one switch, but it corresponds more closely to actual practice, and you soon get used to the sequence of operation.

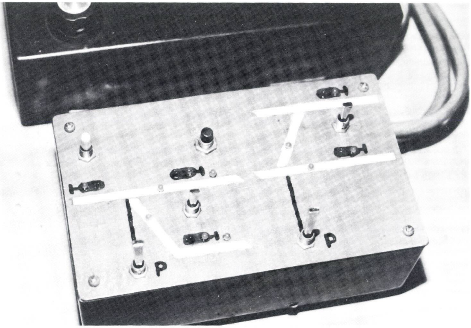
Figure 1 in Part 1, a block diagram, should be referred to again. The solenoids (4) and microswitches (6) of the point mechanism are connected to the relays and switches in the mimic panel box (7), and the lights of the signals (8). A power supply (9) is necessary of course: and it is a crucial part because not only is it expensive, its output voltage determines the choice of other components of your system.

Second circuit

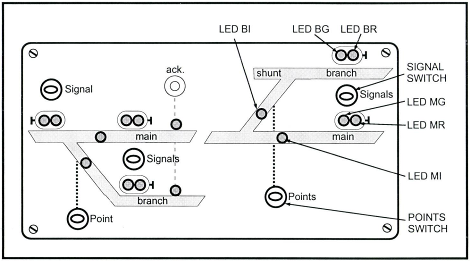
The other half of this particular panel makes provision for a ground reverse shunt signal, and communication with the driver to indicate when ready to shunt. The shunt signal controls trains reversing back into the branch. The driver requests this signal by pressing a key located on a pole near the point, which lights a LED and sounds a buzzer in the signal box. This in turn is acknowledged through the signal box lighting a LED near the driver, so the driver knows to wait. A circuit for this is provided in Figure 16.

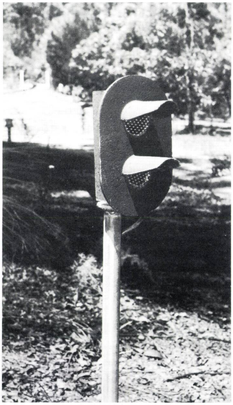
AC power supply

We will need a DC output to power the relays and point solenoids, and AC to power the signal lights. The AC supply will be the larger, as it will need to supply about 10 watts for every lit signal, so let us consider this first. To ensure that spare bulbs are availabe, their lamp voltage will need to be either 12 (as used in cars) or 24 (as used in trucks). All service



The mimic panel, above, controls points in two locations. This article refers to the turnouts represented on the right-hand side of the panel. ***Figure 7*** *below provides a layout sketch and shows the position of LEDs and electrical switches.*





Two aspect signal used in this design

stations and car accessory shops will sell you 12v lamps, but 24v lamps for trucks are preferable considering the long wiring runs around a track and the consequent voltage drop before the lamps are reached. For equivalent light output, a 12v lamp requires more current and this calls for a wire of a heavier gauge.

Figure 8 is a circuit of an AC supply that uses a transformer with two 24v windings connected in parallel. Make sure both winding *starts* are connected together and both winding finishes are connected. The transformer should have a mark or colour code that indicates the start of each winding.

If you have a transformer with a selection of output voltages, as in Figure 9, a higher voltage can be selected at the transformer so that the voltage by the time it reaches the signal is 24v. Note Figure 9 only shows the differences to Figure 8. A 24v circuit can be used for signal lamps close to the control box, a 28v circuit for remote signals, and a 26v circuit for "in between". Check the voltage *at the signal* with a voltmeter to ensure it is not above 24v as you want the lamps to have a long life.

Install fuses or (preferably) circuit breakers at the transformer outputs as the risk of short circuiting in the extensive external cabling to the lamps is high. Mount the fuses/circuit breakers in the same box (shown in Figure 10) that holds the AC transformer, and add the terminal strip mounted on the outside of the box.

The track can form the return leg of the AC circuit, as long as it is not used for some other electrical purpose. If that is the case, you will need to run the return leg of the circuit as a heavy gauge wire alongside the other cables.

The current capacity of the transformer is crucial. Using a 10 watt lamp as typical, calculate the total current requirement by multiplying the number of signals by 10, and divide by 24 or the voltage selected. Don't forget to allow for additional signals in the future. You will quickly come to the realisation that a large transformer will be required.

Good model engineers obtain many components from any source as long as the price is right. If that method draws a blank, Jaycar Electronics have a 25v 12 amp toroidal transformer, category MT-2134. If you have some long cable runs, you may need the 30v 10 amp category MT-2136 also. Radiospares have a 200VA 24v type 208-046. By telephoning transformer retailers found in the

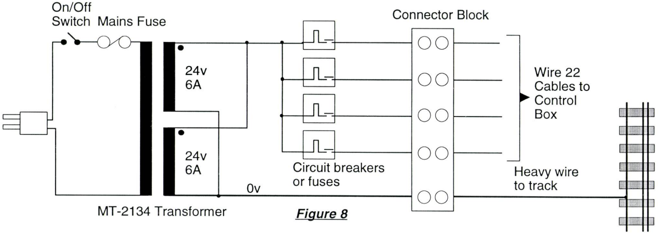


Figure 8

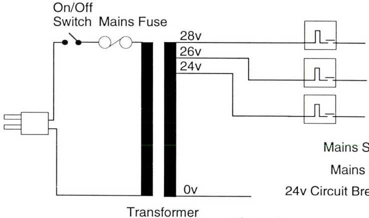


Figure 9

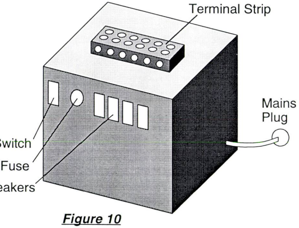


Figure 10

AC Power Supply.

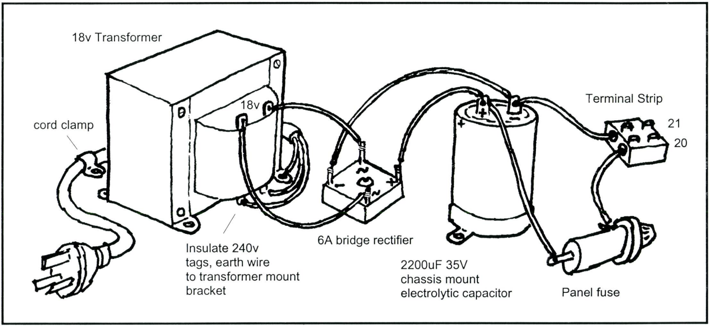

18v Transformer
cord clamp
18v
Insulate 240v tags, earth wire to transformer mount bracket
6A bridge rectifier
2200uF 35V chassis mount electrolytic capacitor
Terminal Strip
21
20
Panel fuse

***Figure 11.** DC Power Supply*

Yellow Pages® you should obtain something suitable.

The transformer can be bolted to the bottom of a metal or moulded plastic case of suitable size, with the mains switch, mains fuse and 24v circuit breakers mounted in suitable cut-outs in one side of the box or in a front panel. The terminal strip is mounted on top for ease of access and all components wired with heavy multi-strand insulated hookup wire as per the circuit. Wiring on the mains side of the transformer should be done carefully to ensure safe and reliable operation — to comply with the law you should have a licenced electrician to do or check this work. The mains cable is clamped firmly to secure it, just after it enters the box via a grommeted rear hole, using a nylon "P" clamp. The earth wire (yellow/green) is soldered to a tag that is either bolted to the metal case or secured to a transformer mounting foot. All mains voltage wiring should be well insulated.

DC power supply

A source of 24v DC is also required to drive the relays and point solenoids. Your voltage choice, however, may depend on your supply of "the price is right" relays. In that case, select your point solenoid voltage and DC power supply voltage to match your relays. This time the current drawn is light, and 2 amps will be sufficient for the circuits to be described. It may be worthwhile checking irrigation supply stores, as 24v power supplies are available for home irrigation systems.

If you have selected 24v as your relay and solenoid voltage, you will either need an 18v tapping on your AC supply transformer, or a separate 18v transformer. If your choice of AC power supply case was generous, all DC power supply components may fit here also.

The only additional components required for a DC supply are a diode bridge, electrolytic capacitor and a (2A) panel fuse. The bridge and capacitor have mounting holes or brackets to secure them to the case. The supply and wiring is shown in Figure 11.

Soldering and other techniques

The scope of this article does not allow for more detail on such things as soldering techniques and what is the difference between an electrolytic capacitor and a ceramic capacitor. For this you will have to refer to books which are readily obtainable from your local library and retailers such as Dick Smith. As you can gather from the general tenor of the writing, there is likely to be a wide variation in components actually obtained and used, preventing a complete "blow by blow" description.

Solder all joints using electronics-type resin-cored solder on a reel, and hold the iron on the joint only long enough to ensure the solder "flows" across both wire and tag. Beware of "dry joints", where the solder looks globular, as an electrical contact may not exist or may be unreliable.

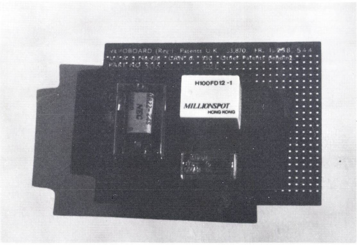
If you plan to use the club 150 watt Birko soldering iron for soldering the power supply components together, I would advise against it and suggest you buy a smaller 25 to 40 watt iron from Dick Smith, Jaycar Electronics or similar stores.

Cable and distribution

Signal lamp cable needs to be substantial in order to carry half an amp for some distance without appreciable voltage drop. 240v mains cable is not recommended as it will be difficult to terminate at intermediate termination boxes, and only provides three wires per cable run. A suitable size and supply can be obtained from computer data cable, which is commonly obtainable in 6, 9 and 25 wire combinations with each wire 7 strand 0.2mm copper minimum. You will need lots of this and a visit to building demolishers may be advisable (or radio/TV studios doing a reconditioning after a change of ownership) for recovered computer cable. Distribution boxes situated strategically around the track allow for concentration of local cables into one main cable back to the control box. A photograph of such a box is included, this one using telephone tag blocks screwed inside street lighting electrical boxes. These items can be obtained second hand from electrical and telephone installers.

Control box and mimic panel

The control box provides a location for the relays, and the mimic panel provides the mounting for the switches and LEDs. The



Three styles of PC mount relay on a sample of Veroboard

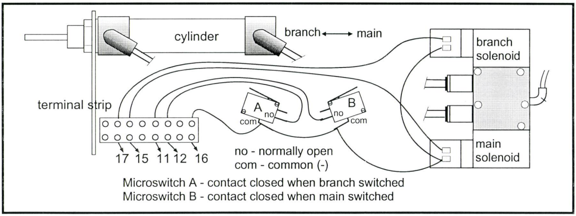


Figure 12. This is Figure 6 re-drawn to show electrical wiring

mimic panel may be merely the lid of the control box, or these two units may be separated if required. In this description the two are combined for simplicity.

Electronic retailers have a wide range of cases to choose from. The one shown in the photograph is a simple plastic "Zippy Box", with a heavier gauge metal lid replacing the rather flimsy aluminium one supplied. The size will depend on your plans, but generally:

a) buy one with a large lid or front panel to provide lots of space for the track diagram

b) get the biggest you can as it is easier to work with and gives lots of room for expansion

c) go for sturdy construction — it stands up to a club environment better.

Jaycar have an ideal desk console box (category sizes HB6090, 6092, 6094). Otherwise see if Dick Smith category H-2201 or Jaycar HB-5050 cast aluminium boxes suit your need. You can always build your own of course, and this will be necessary if you want something larger than the above. The desk console design is a good one for our purposes.

Circuit operation

Referring to the circuit of Figure 13, the relay coil is shown as a heavy "zig zag", with the contacts for that relay in a line beneath. When a relay is energised, the centre leaf of each contact set moves *towards* the coil.

Relays B and M control the branch and main signal and mimic panel LEDs respectively. These relays are operated by the signal switch through contacts of the PC1 (for branch) and PC2 (for main) relays. As PC1 and PC2 are operated by the point microswitches, the position of the microswitch thus controls the lighting of the signals.

Relays B and M must be released before a voltage is applied to the common (wire 29) of the points switch. Thus if either B or M is operated, the points solenoid cannot be energised.

Circuit board

Relays are mounted on a piece of Veroboard® cut to fit the case. The cut board is screwed at each corner to the base of the box using 10mm plastic standoffs. Veroboard is a "do it yourself" printed circuit board and consists of etched parallel copper strips that are pre-drilled and ready to fit and solder relays and other components. Similar printed circuit board is sold as "Printed Stripboard" by Dick Smith (Category H-5616) and "Vero type strip" by Jaycar (Category HP-9540, 9542 or 9544).

Figure 14 shows the board layout, components and wiring. The wires connecting various external components of the circuit have been numbered so you can follow them through. For example, in Figure 11 wires shown are 21 and 20 which connect to 21 and 20 in Figure 13.

The circuit is completed by cutting the copper strips and soldering straps where required. Two sides of the board are shown. Where a strip of copper needs to be cut (the positions are clearly shown as black circles in the copper side drawing) use a 2.5mm drill in a tap handle to remove the copper without going too far into the fibre base. Several insulated wire straps are also required, with three under the board.

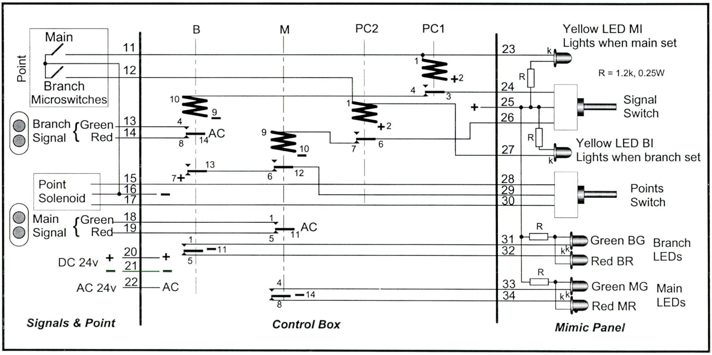
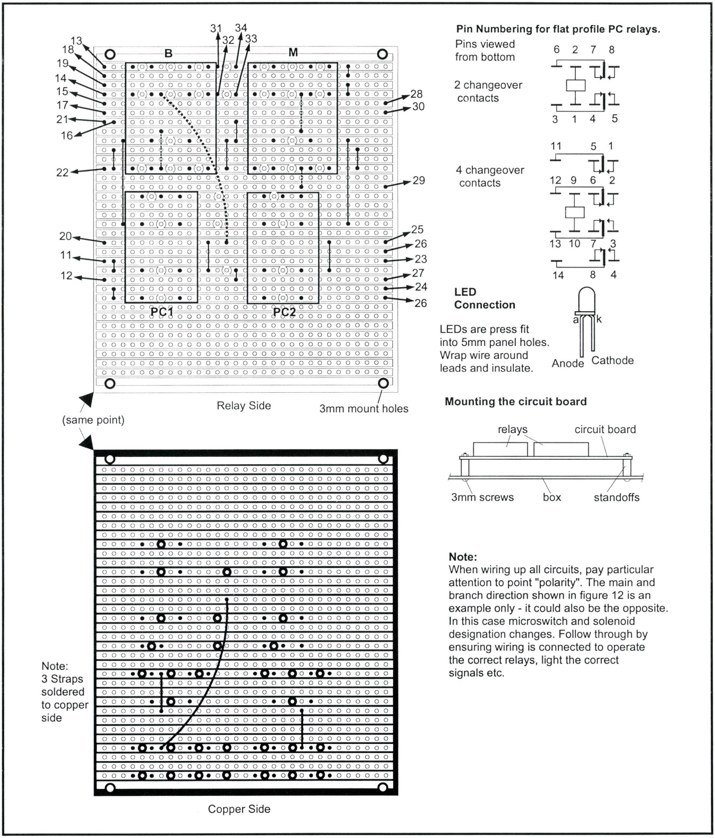


Figure 13. Complete circuit diagram showing both external and control box wiring.



LEDs are press fit into 5mm panel holes. Wrap wire around leads and insulate.

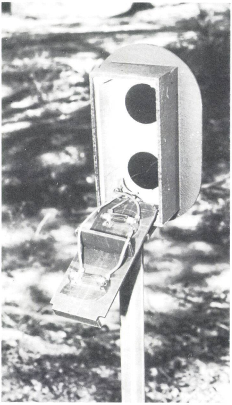
Note:
When wiring up all circuits, pay particular attention to point "polarity". The main and branch direction shown in figure 12 is an example only - it could also be the opposite. In this case microswitch and solenoid designation changes. Follow through by ensuring wiring is connected to operate the correct relays, light the correct signals etc.

Figure 14. *Circuit board construction.*

Relays

Relays are of the low-profile printed circuit mounting 24v (or selected voltage) type, with at least 1A DC resistive contact rating. This specification provides a very wide range of brands and designs, so it's over to you on what you can find at the right price. You also need to specify the number of change-over contacts as per the circuit requirement of course. The photo on page 44 shows a sample piece of Veroboard with typical printed circuit relays mounted on it.

Retail electronics stores such as Dick Smith and Jaycar do not appear to carry four changeover types in these designs so you may have to try more specialised stores. Radiospares (RS Components Pty Ltd) carry miniature low-profile flatpack relays in two



Rear of signal opened, showing fibre backboard for mounting lamps.

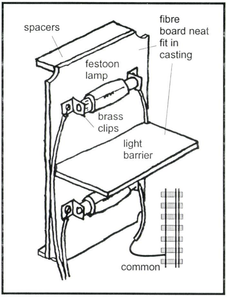


Figure 15. *The fibre insert for the signal casting that holds the lamp retainers.*

(348-649) and four pole (348-611) configurations. Makers of these "standard" relays include National, NEC, Siemens, Taiko and Omron. Cradle relays (vertical type) are often obtainable second-hand; these are larger and require sockets for printed board mounting.

Pin configuration for the PC relays used are given in Figure 14, but check the ones you are to use as even though these low profile relays are standard in size and pin layout, numbering can vary. Well, we couldn't have things *that* standard could we? Before going any further, re-number the circuit to suit your relay.

And finally, of course, you may be able to put your hands on those relays beloved of the model railway (HO etc) fraternity, the old PMG relay. When visiting model railway shows I'm amazed at the lengths the modellers must go to find the oldest electronic components possible. Where *do* they find it? Lovely big black bakelite handles on switches etc — think of the heritage value! Mind you, they probably stand up better to a five minute application of a 150 watt soldering iron. Don't do that with modern components! If you plan to use this type of relay, make sure you have the room in your case.

Wiring the point solenoid

Connect up the electrical components of the point motor as per Figure 12 with heavy multistrand insulated wire. Refer also to photographs in Part 1. If you have two points operating together, as in a crossover, wire the branch solenoids in parallel, the main solenoids in parallel, the branch microswitches in

Electrical Parts List

QTY	Material	Supplier
1	240v to 24v transformer 200-300VA	See text. Jaycar MT2134, Dick Smith M1610 (2x28v), RS Components 208-046
1	240v panel mount on/off switch	Dick Smith P7705, Jaycar ST0572
1	Panel mount fuse holder and 2A fuse	Dick Smith P7916, Jaycar SZ2025
a/r	Circuit breaker	Jaycar SF2252 (3A), SF2254 (5A), SF2258 (10A), Dick Smith P8203, -05, -10.
1	240v plug and cord	Jaycar PS4110, cable clamps Dick Smith H1966
1	Box	See text. Jaycar HB5468, Dick Smith H2814
1	Terminal strip	Dick Smith P4855, Jaycar HM3198
1	240v to 18v 2A transformer	See text. Dick Smith M1991 (17.5v), Jaycar MM2005
1	6A bridge rectifier	Dick Smith Z3306, JaycarZR1314
1	2200uF35v chassis mount electrolytic capacitor	Jaycar RU6746 (Dick Smith 2500uF 80v R4572)
1	Panel mount fuseholder and 2A fuse	Dick Smith P7916, Jaycar SZ2025
1	240v plug and cord	Jaycar PS4110, cable clamps Dick Smith H1966
1	Box	See text. Jaycar HB5468, Dick Smith H2814
1	Terminal strip	Dick Smith P4855, Jaycar HM3198
2	5mm Red LED	Jaycar ZD1710, Dick Smith Z4085
2	5mm Green LED	Jaycar ZD1715, Dick Smith Z4087
2	5mm Yellow LED	Jaycar ZD1720, Dick Smith Z4089
1	Single pole d'ble throw (SPDT) centre off switch	Jaycar ST0558, Dick Smith P7684 (DPDT), RS Components 318-632
1	SPDT centre off momentary action switch	Dick Smith P7650 (DPDT), RS Components 317-033
4	1.2K 0.25W resistor	Dick Smith R0576, Jaycar RR0574
1	Box	See text. Dick Smith "Zippy" box H2852, Jaycar desk console HB6094
2	2 c/o low profile 24v PC mount relay	RS Components 350-16. (National NF2E-24V)
2	4 c/o low profile 24v PC mount relay	RS Components 350-197 (NEC MR24-24S, Omron Type LZNQ)
1	Veroboard® or similar	Dick Smith H5112, Jaycar HP9540
4	Mounting posts & screws	Dick Smith H1861, Jaycar HP0900&
a/r	Signal castings, fibre board and 10W lamps	See text

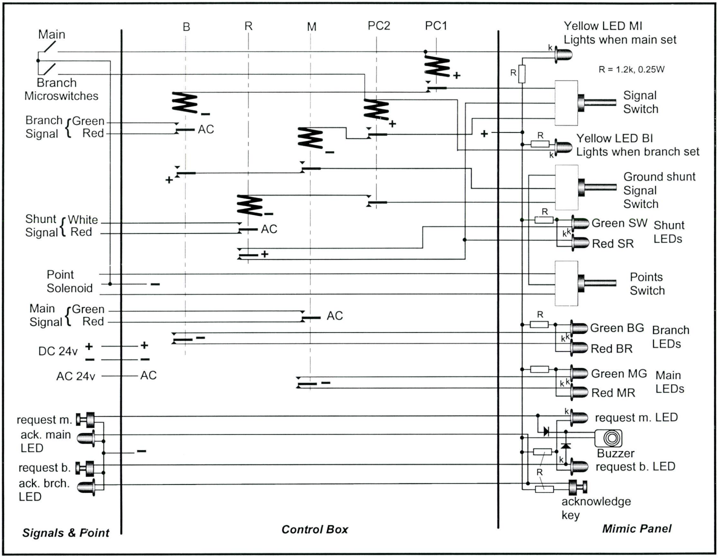
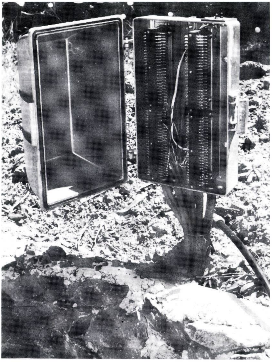


Figure 16. Circuit for a points configuration that includes a ground shunt, and communication between driver and signal box for requesting point change.



External distribution box for track cabling.

series, and the main microswitches in series. Thus to switch the point to main, both main solenoids operate together, and both main microswitches must be made before an indication is returned to the control box.

Signals

Signals are aluminium castings and those that relate to this article are two-aspect. If you would like help to obtain signal castings, contact Brian Carter or Neil Graham at AME and we'll see what we can arrange. QSMEE also use castings for three aspect and ground shunt signals.

The castings, which have a suitably located cast-in boss, are mounted on the end of a length of galvanised water pipe concreted in the ground. The lenses, cut from ripple plastic obtained from fluorescent light diffusers and sandwiched with a piece of plain clear plastic of appropriate colour. They are glued in the holes in the casting. Demonstrating to the office manager the increased light level advantages of fluorescent lights with no diffusers is an effective supply ploy here!

Lamps of the 10 watt festoon type are held between two springy angle brass contacts screwed to a 3mm fibre/plastic back board that is a neat fit in the back of the signal casting. Suitable festoon lamps are available in two slightly different lengths, so make sure you stick to the one size in all your signals and spares. The lamps must be accurately centred on the lenses and should be of a reputable brand. We have found the cheap Asian imports poor value, with a quickly deteriorating light level and limited life. A photograph shows signal construction.

The plastic backboard also has a divider glued between the two lamps to avoid light spill, and another two plastic strips to hold the backboard off the metal cover, which is attached to the casting at four corners.

Your signal will be a practical and realistic addition to the track. Now, about that night run....

Repairs To Locomotive Boilers on the Victorian Railways

Fire Tube Removal and Repairs

By Doug Baxter

Drawings for publication by Terry Kerr

From the *Rolling Stock Book of Instructions* section on Boilers:

Item No. 98: Every locomotive boiler except those with steel tubes must have the tubes withdrawn and the boiler and firebox thoroughly examined by the Workshop Manager concerned, and the Foreman Boilermaker, Newport, at the intervals and under the conditions set out hereunder :

(a) The first examination must be made when the locomotive has run 230,000 locomotive miles, or when a period of seven years has elapsed, whichever event may sooner occur; but if the mileage above-mentioned is run in under six years the locomotive is not to be withdrawn from service until a period of six years is completed.

(b) The second examination of the boiler must be made when 130,000 locomotive miles has been run, or when a period of four years has elapsed subject to the proviso contained in subclause (d).

(c) After the above periods have been completed the boiler must be examined when a further 100,000 locomotive miles have been run, or when a period of two and one half years has elapsed, subject to proviso contained in sub-clauses (d) and (e).

(d) If any boiler becomes due for the second or any subsequent examination by effluxion of time is found to have run a low mileage, the Workshops Manager, Newport, may if considered desirable recommend for that boiler to be kept in service for a further period.

(e) Every locomotive boiler that has undergone repairs of such a nature as to make it fit for replacement purposes should be examined by the Workshops Manager concerned and Foreman Boilermaker, Newport, so that, should the circumstances warrant it, such boiler may be regarded as having had the tubes withdrawn for the first time, and consequently they should not be withdrawn until 130,000 locomotive miles have been run, or a period of four years has elapsed.

(f) A complete record of the life of every boiler is kept in the Chief Mechanical Engineer's office and also in the office of the workshop manager, Newport.

Moving on to **Item No.112**.

When brass tubes are withdrawn, they must be thoroughly cleaned and examined and checked for the correct weight in accordance with the schedule hereunder. Any tube for the minimum weight specified in the schedule, or which is less than No. 11 BWG at the smokebox end must not be used in any boiler (see table below).

Item No. 113: When knocking up brass tubes care must be taken to see that there is

Schedule of New and Minimum Weights of Boiler Tubes (Brass)

Class of Engine	Diameter of Tube (inches)	Approximate Weight New (lbs)	Lowest Weight (lbs) 1st Examination	Lowest Weight (lbs) 2nd Examination
A1 & A2	2	42	36	32
C	2	43	37	33
D1, 2,3 & 4	2	37	32	28
E	2	31	26	23
G	1¾	23	19	17
K	2	40	34	30
N	2 ¼	59	49	44
NA	2	34	29	25
Y	1¾	26	22	20

From the above schedule it can be seen the loss of weight to second examination was 25%

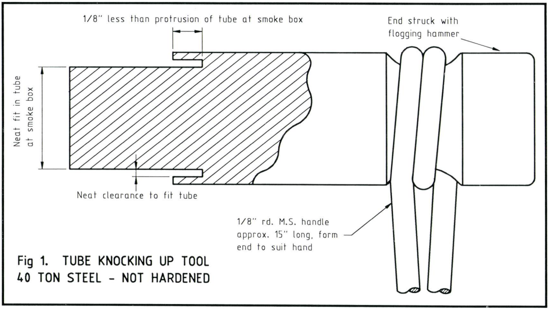

1/8" less than protrusion of tube at smoke box
End struck with flogging hammer
Neat fit in tube at smoke box
Neat clearance to fit tube
1/8" rd. M.S. handle approx. 15" long, form end to suit hand

Fig 1. TUBE KNOCKING UP TOOL
40 TON STEEL - NOT HARDENED

sufficient projection at both ends of the tube to ensure good service. If the end of a tube is within the face of the smokebox tubeplate it must be renewed.

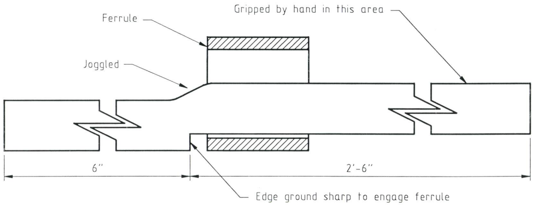

Ferrule
Gripped by hand in this area
Joggled
6"
2'-6"
Edge ground sharp to engage ferrule

Fig 2. FERRULE BAR
3/4" SPRING STEEL - HARDENED

Item No. 114: When brass tubes project less than 1⁄16th inch at the smokebox tubeplate, the Boiler Inspector must be notified and he shall decide whether the tubes are to be renewed.

Item No. 116: When a brass tube is found leaking at the firebox tubeplate and the end of the tube is level or within the face of the tubeplate, it must be knocked up or renewed as may be found necessary.

Item No. 117: Tube drifts must not be used under any circumstances for expanding locomotive boiler tubes. Great care must be exercised when expanding them in order not to enlarge or elongate the tube holes in the tubeplate. Only qualified employees must be permitted to expand, bead or weld boiler tubes in position.

At the original application of either brass or copper fire tubes the amount of protrusion at the smoke box end was about ½", this was to allow for the knocking up of the tubes if or when the beads have lifted and became burnt.

The tool in **Fig. 1** was used, having different diameters to fit various tubes and depth of groove to suit the protrusion at the smokebox, a tool having a clearance of ⅛" is chosen. Firstly remove the ferrule at the firebox end with ferrule bar — **Fig. 2**. It is approximately 3 foot long, with the lip about 6" from the end pushed into the tube about 2" to 6", withdrawn smartly with the lip engaging the ferrule. Usually the first thump will remove the ferrule.

If a large number of tubes are required to be knocked up it may be necessary to have the elements and blast pipe removed. The tool is placed in the tube and the head is struck with a flogging hammer until the face of the tool engages with the smokebox tubeplate. The usual amount of knock up is about ⅛". The tubes are then expanded at the firebox end first then the smokebox and a new ferrule applied and beaded at the firebox end.

On NA (Puffing Billy) boilers it was necessary to renew the ferrules only after a few years as they were cut out at the top area due to the cinders. Copper tubes were not knocked up. When it was necessary to remove a copper or brass tube it was cut clear at both ends using the tool as in **Fig. 3**. It can be either used by hand or driven by a pneumatic machine. The nib is eccentric to the centre of the tool and when the point touches the inside of the tube the eccentric action takes place, punches the tube and continues to rotate shearing out a section about ⅛" wide. The same tool is used at both ends. The ferrules are removed from the firebox end before applying the cutter. The shell remaining in the tube plates is removed by either a hand or pneumatic chisel. In replacing the tubes the same procedure is used as for new tubes.

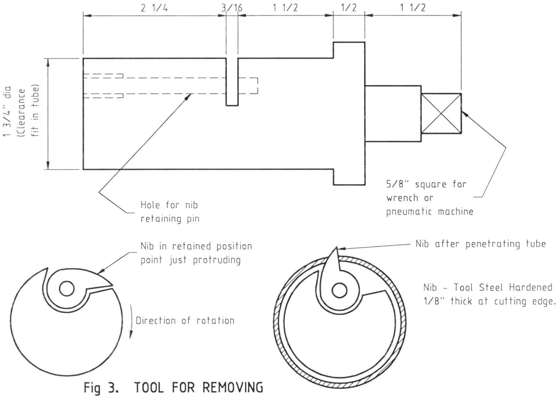

2 1/4
3/16
1 1/2
1/2
1 1/2
1 3/4" dia (Clearance fit in tube)
Hole for nib retaining pin
5/8" square for wrench or pneumatic machine
Nib in retained position point just protruding
Direction of rotation
Nib after penetrating tube
Nib - Tool Steel Hardened 1/8" thick at cutting edge.

Fig 3. TOOL FOR REMOVING
COPPER OR BRASS FIRE TUBES

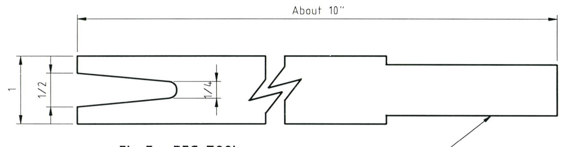


Fig 5. PEG TOOL
TOOL STEEL

Copper flue tube repairs and removal

It was quite common that at the end of the seven year period when the first examination of the interior of the boiler must be carried out that the flue tubes were in very good condition. So to permit ingress to the boiler barrel only the centre two rows were removed. After the necessary repairs were carried out the boiler was then sent out for a further period of four years. During this time some of the original flue tubes begin to show signs of the beads starting to lift and burn and the following procedure was carried out. The tubes were lightly expanded and ferrules — **Fig. 4** — were applied. These ferrules were made from ferrule steel 1½" x 3⁄16" and were about 40 tons tensile. They were fire welded to various diameters to fit the approximate internal diameter of the flue tube at the firebox end. The end was scarfed in the lathe, heated to a red heat and left in lime overnight to anneal. The fit being a light driving fit in to the tube, leaving about ½" protruding for beading. Then lightly expand and commence to lay the bead over with the ball pein of a light flogging hammer and finish off with a hand or pneumatic beading tool. Finally a very light roll with the expander as the beading may have slightly loosened the ferrule. These were known as "Protection Ferrules".

To remove copper flue tubes which were screwed into the firebox tube plate it was firstly necessary to cut off the bead by either hand or pneumatic chisel. Then using a quarter inch cross cut chisel, either hand or pneumatic cut a groove on each horizontal side centre line being particularly careful not to go into the threads. Take these grooves about one inch beyond the inside edge of the firebox tube plate, then using a suitable sized and shaped gouge lift the bottom section of the tube clear of the threads. The tube at this area is 3⁄16" thick and when this section of the tube is well clear of the tube plate the weight of the tube will cause the tube to drop clear of the threads at the top.

By the time flue tubes for super heaters were introduced about 1914 the oxy-acetylene gas process had arrived. The procedure at the smokebox end was as follows; using a large heating tip heat the end two inches of the tube to a dull red and using a suitable shaped tool — to suit the outside radius of the tube, about 2’ wide with a suitable handle attached — close in the tube from the bottom centre working up to the horizontal side centre line. This operation may require about six heats and close ins. Eventually the tube will drop a fraction at the top showing the expansion has been broken. Returning now to the firebox end using a peg tool — **Fig. 5** — in a large size pneumatic riveting gun, engage the section at the bottom lifted up by the gouge and drive the tube out well clear of the expansion at the smokebox end. Suitable staging to the height of the smoke bottom and longer than the flue tubes was necessary. Firstly a rope was placed around the protruding tube and withdrawn about half out, then the overhead crane took over and eased the tube clear of the smoke box tube plate, and laid them in suitable racks.

Before replacing flue tubes the threads in the firebox tube plate were cleaned up by hand. Replacement tubes were applied in the same method as for new tubes. All tubes from copper firebox boilers were treated in the rumbler located at No.50. on page 46 AME February 1989. After being rumbled free of scale etc they were inspected and weighed to see if they were suitable for reconditioning. Fire tubes were reconditioned by removing the damaged ends in the tube lathes. One end lightly skimmed for about ½" and a new section about 12" long, flared as **Fig. 6**, applied by Tobin Bronze using the oxy-acetylene. The surplus material was ground off and each tube subjected to a mains pressure test. Finally the tube was swedged to the required diameter.

With the scarcity of brass during World War II the length of the replaced section was permitted up to 26". Drawing Loco Class No. 5267 refers to Flue Tubes Solid Drawn Brass

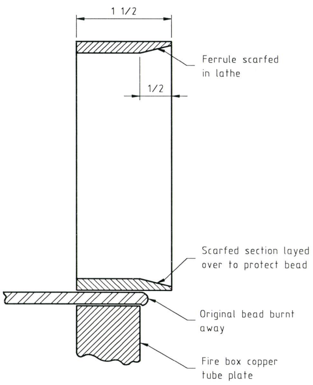

1 1/2
Ferrule scarfed in lathe
1/2
Scarfed section layed over to protect bead
Original bead burnt away
Fire box copper tube plate

Fig 4. PROTECTION FERRULE
40 TONS PER SQUARE INCH TENSILE STEEL

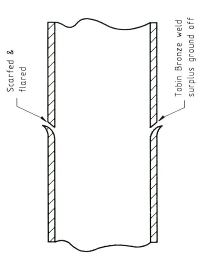


Fig 6. PREPARATION FOR & WELDING
NEW ENDS ON RECONDITIONED
BRASS FIRE TUBES

or Copper, Arranged for Screwing was superseded by Drawing No. 5267A referring only to "Solid Drawn Copper" dated 16-12-1932 thus eliminating brass flue tubes. With the introduction of oil burners about 1950 it became apparent that flame was beginning to have a serious effect on the beads of both flue and fire tubes fitted to copper fireboxes. Correspondence R.S. 53/3823 states that "The service to which the boilers of oil burning 'C' class locomotives are subjected is causing deterioration of the copper flue and boiler tubes to the extent which suggests that first period copper firebox boilers will be required to be retubed after about four years." Under coal burning this was a seven year period.

Removal and repair of steel fire and flue tubes

The beads of all steel tubes were seal welded. In the case of the fire tubes a facing tool — **Fig. 7** — was used to remove the bead and seal weld. The cutter was high speed steel, 5⁄16" thick with a cutting edge at each end, the length depending on the diameter of the tube being removed. Care had to be taken to operate this tool at right angles to the tube plate so as not to gouge into the plate on one side, as a tool large enough to clean off the bead of a flue tube would be heavy to operate. These beads were removed by pneumatic chisels and any surplus of the weld removed by hand grinders. The cutting tool was driven by a large pneumatic machine.

The tool to cut down steel tubes was similar to that for copper except that the nib was a different shape retained by a pin on which it slides. It was necessary to drive this tool by a large pneumatic machine. This tool was also used at the smoke box end. The section remaining in the firebox end with the copper liner was removed by a pneumatic gouge and the same procedure was applied at the smokebox.

Steel flue tubes were removed in a similar manner to copper. A groove cut with a pneumatic cross cut chisel on the horizontal centre lines just past the inside of the firebox tube plate. The bottom section tucked up slightly till it was observed that the expansion had been broken. The smokebox end was similar to copper except it did not required as much heat and complete removal occurred using the peg tool etc., as for copper flues.

Problems occurring with steel tubes

Fin holes occurring in steel fire tubes on the right hand side towards the smokebox due to the introduction of feed water from the fireman's side injector - the oxygen being released from the water at this point. These fine blows retarded the flow of cinders down the tube and in conjunction with the sediment in the water formed a cement substance blocking the tube and also sealing up the leak. This tube would be blocked at the examination by the inspecting boilermaker and if it showed no signs of leaking it would often left as is. If the long auger was put through to clear it, it was necessary to replace a leaking tube. One blocked tube had no effect on the boiler steaming.

Both flue and fire tubes were originally applied with copper liners and this caused electrolysis to eat into the tubes where the prossering occurred. The surface being broken by the prosser speeded the action. If the tubes were allowed to remain in over four years this always became a problem by causing leaks. It could be temporally repaired by applying blanks at both ends of the tube. In the case of fire tubes, these blanks were usually made from sections of solid drawn element tube, one end being plugged by arc welding a steel disc in. The other end was annealled and drifted to be a neat fit in the tube, allowed to stand proud about 1⁄4" then expanded in. The same procedure was used at the smokebox tube plate. Blanks could not be applied to flue tubes but due to their thickness it was possible to seal leaks by the arc welding process using a 12 gauge electrode using multi-runs.

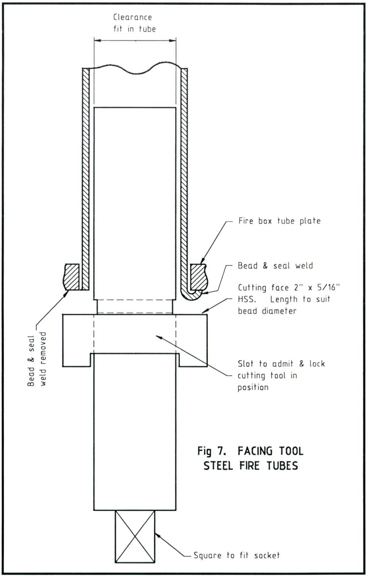

Clearance fit in tube
Fire box tube plate
Bead & seal weld
Cutting face 2" x 5/16" HSS. Length to suit bead diameter
Slot to admit & lock cutting tool in position
Bead & seal weld removed
Square to fit socket

Fig 7. FACING TOOL STEEL FIRE TUBES

Both flue and fire tubes were also subject to radial cracks forming in the beads. In the case of flue tubes they could be sealed using the arc to prevent further cracking leading to leaks. Due to the thin beads of fire tubes this was not possible so a ferrule as used in copper fire tubes would be applied.

Instruction 57/11146 of 4 August 1958 states:

"Where the bead of a steel boiler tube shows signs of cracking and is too thin for a weld repair to be effected, it may be repaired by applying a steel ferrule in preference to renewing the tube.

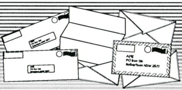
In such cases the following procedure is to be adopted

1. Re-expand the tube to be ferruled.
2. Lightly rebead tubes where bead has lifted from the plate.
3. Prepare and drive a steel ferrule into the tube until flush with existing bead.
4. Submit the tube plate diagram indicating tubes that have been ferruled."

In the early 1960s with the steam era coming to an end the introduction of portable electric right angle disc grinders the beads and arc welding seal were removed by this process. The tube plate was cleaned up at the same time and when tubes were reapplied no copper liners were used thus allowing a longer life for the fire tubes as no electrolysis occurred.

Steel fire tubes removed after a four year period were often in very good condition due to satisfactory feed water treatment. They were reconditioned by removing about 10" at the firebox end and butt welding a new section on. The flash being ground off and the end swedged to suit. When flue tubes were reconditioned the new end was applied by oxy-acetylene welding. It was possible to have about eight fire tubes blanked before consideration would be recommended for the boiler to be retubed.

Letter Box



A bitter taste

Sir,

Last weekend I inspected a 5" gauge locomotive which had the week before suddenly developed a two exhaust beat exhaust instead of the usual four. The reverse eccentric on the right had side had slipped around the axle preventing that valve from opening the ports. This was revealed when the locomotive was turned over. With the load removed form the axleboxes these were found to be very sloppy in the frames as were the axles in the axleboxes. The front coupling rods appeared to no longer have bushes in them as the front axle could be rotated about ⅜" at the rim without anything else moving. The rest of the motion was no better.

The owner had just purchased this locomotive and this was his first run. He had been assured that the locomotive was a good performer and he would get many years use out of it. I was not present at the steaming but those who were said that its performance was not so good. It would not hold steam pressure on Blair Athol coal even with a load. The blast pipe was nowhere true to the chimney, being almost ¼" behind and to one side of the petticoat pipe. The grate had only about ⅛" air spaces and the ashpan had the usual restriction over the rear axle.

The point to this letter is that we, as experienced model engineers, should be responsible and honest when selling our models. Many purchasers do not have the experience to know what is a good or bad buy nor do they have the facilities to carry out repairs or a rebuild should it be necessary.

In the above case, the purchaser is now reliant on others to effect the necessary repairs. He was naturally quite disappointed with his purchase and needed some reassurance that he had not bought a complete *lemon.*

Peter Lukey, Qld.

Mill memories

Sir,

I recently received my copy of the AME and would like to express my thanks, and to say how much I enjoy it. Always look forward to its arrival, an article in this issue, interested me, written by Mr Dave Harper, entitled, "A Steam Chest Special", all about the wonderful old steam engines at the Mill in Maryborough, Qld. I was involved in the sugar industry for the last ten years of my working life, and was a maintenance fitter and turner, at the Franleigh Sugar Mill, in Mackay, Qld. I retired from there five years ago.

However my main reason for writing you was to draw your attention to something that may interest you regarding some mill engines, also in Queensland, you might like to pass this information on to Mr Harper. If he does not already have knowledge of these engines it would be great if he could do a write up on them for the AME.

These units are still in operation driving Mill Rolls at Hecks Sugar Mill at Rocky Point near Beenleigh in Qld. This is the smallest Mill in the state and is privately owned by the Heck family. These engines were built by Sargeants Engineering in Brisbane, their workshops being in Alice St., opposite the Botanical Gardens, where the Park Royal Hotel now stands. They were established there for almost one hundred years and next to Walkers Engineering in Maryborough were the largest manufactures of Sugar Mill Equipment in the Southern Hemisphere. At one stage of my working life I was employed by them during the 1960s and 70s. The firm was eventually gobbled up by Aust. National Industries and then like many other engineering shops, fell by the wayside sometime in the 1980s.

Well, hope I am not boring you with all this, and that you may find some of it of interest. I would like to take this opportunity to say what a great magazine you produce, and to wish all a very happy Christmas and everything good for the New Year.

Roy Florent, NSW

How about a steamer?

Sir,

Would it be possible to see in our magazine a construction series of an Australian design locomotive, as there are a number of firms supplying castings for NSW and Queensland steam locos in 5" gauge.

Good for experienced builders, but to get newcomers into our hobby we need articles to give them a guide to the many pitfalls to the beginner. I was one of them, and have a 5" loco now finished after lots of troubles and headaches with leaks and design problems and alterations to get it working properly.

It now goes pretty well and looks good on the track. It is not an Australian design, a different looking *Sweet Pea.* But I would like to build an Australian type but my age might stop me finishing it. I might still have a go anyway. You can see we need newcomers and information articles to put them on the track.

AME is still a great magazine. I am a member of a small private club up here (six of us) but we really enjoy our hobby.

Eric Lucoc

Thanks Eric for your vote of confidence in AME. With the electric powered 422 almost finished, AME is well aware of the need for a steam loco project. In fact, we have had one in preparation for some time, and I am sure it will be well received when the series commences. The steam loco project is in an advanced stage but it will not be published until all the episodes in the series are ready. This is to avoid gaps in the publication, as we have experienced with the 422 series from time to time. In the meantime we have a few interesting short projects to keep you in shape before the steam locomotive eases out of the roundhouse!.. bmc

Buyers beware

Sir,

After completing enough of our new club track, I took my NSW 12 class engine up for a test run. When I built this engine, my first, I fitted an oversize axle pump, as I wanted to be sure it would supply 110% of the water required.

After several runs, and the axle pump bypass tap opened to give the required ½ glass of water, I did a run without checking the water level (a case of over confidence), when I suddenly ran out of steam pressure. With no water indicated in the glass, this required frantic action on the tender hand pump but to no avail. The fire was dropped, and on returning home, the boiler was filled with water and tested with 100 PSI air pressure.

Sure enough I had a pin hole leak in the fire box at one of the upper side stays. This caused deep despair at the thought of removing the boiler and fittings to allow repairs to be carried out.

On removing the two pressure relief valves from the boiler, I noted that I could see the shiny ball inside one valve but could not see the ball in the other.

On dismantling the valve I found the ball a rusty mess. I then dismantled the axle pump and found both balls rusty, with rust on the seat of the inlet valve, hence no seating of the ball. The next job was checking the balls in the hand pump and they were found to both be black and a film of rust was on the inlet seat.

After repairing the boiler I made a twin gauge testing rig for the boiler, but as it took me a while to repair the boiler it had water in the hand pump of the tester for a month. When I removed the valves from the hand pump, both balls were starting to go black.

All the balls and relief valves came from a well-known supplier in the UK, so I'm not impressed with their quality control.

I have, a little late, been advised to always soak and test the so-called Stainless Steel balls before use. A warning to all builders.

M. C. Rachow, NSW

News Desk

compiled by Brian Carter

Area representative

We have a vacancy for a South Australian area representative. If you think you may be interested in representing AME at a local level, and by sourcing out local stories and events, call or write to me. Like all AME "jobs", this is a voluntary one. It isn't onerous, but it does give you the satisfaction of knowing you are helping our fellow hobbyists.

Phone and fax number change

From July 1996 my phone and fax numbers will be: phone (02) 9649 5301,
fax (02) 9646 1362.

60 Class books

AME Retail have no more supplies of this book. To our knowledge there are no plans for a reprint — but we can live in hope!

Back issues

We recently came across a few copies of several issues of AME prior to issue number 32. They have been added to the back issues listing. Check to see if there are some that you need for your collection. There's not very many, so don't leave it too long!

422 article

I'm sure that Mr Phillips of Queensland will be delighted (Letter Box, AME Nov-Dec 1995), but to our 422 constructors our apologies for missing this issue.

We intended to present the various colour schemes applied to the class. However, the article has been held over until the May issue because the research took longer than anticipated due to the many subtle variations — even among the same colour schemes! I'm sure that the locomotives were constructed with standard parts, but the SRA paint shop seems to be in a world of its own!

All of the major colour variations will be presented in full-colour, so don't miss out on the May issue. This information may also be of value as a painting guide for builders of other classes of NSW SRA diesel locomotives.

AME's 42218 is virtually complete. It has been to a few Sydney clubs on impromptu visits. We hope to make up an official tour around the country a little later on: we'll keep you informed. You may even see it at the AALS convention.

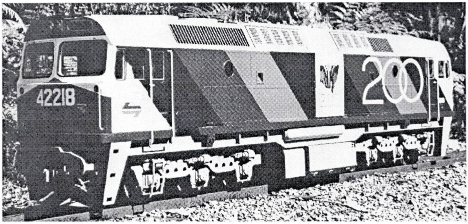
3rd Model Engineering Exhibition

I have received notification from the organising committee that the exhibition will be on 5 and 6 October 1996. This exhibition has been moved from Rowville to Monash University in the Melbourne suburb of Clayton.

Try to give this event all the support you can. It is a great opportunity for the general public to meet model engineers when they have time to talk and are not behind the throttle or working on the running day support staff. It also lets model engineers see each others' achievements under fairly relaxed conditions.

Trade and commercial

Hare & Forbes Pty Ltd will be holding their 3rd annual sale and demonstration day from Thursday 16 May to Sunday 19 May. This sale is of particular interest to model engineers. Besides the many extra special machine and tool prices and the Rotary Club barbeque, there will be many practical demonstrations. The Hornsby and District Model Engineers will have a large display of members' work. Some of the members will be operating metal lathes and other equipment to manufacture model engineering related projects. It's a great opportunity to ask questions of seasoned model engineers. There will be woodturning and other wood related demonstrations by experienced operators. Another feature of this weekend is the presence of trade technical representatives to help answer those special questions you might have. See their ad on page 2.



AME's 42218 sporting her Bi-centenary colours. This photo was taken before the stubby buffers and windscreen wipers were fitted. Location: Wascoe Siding, Blaxland NSW.

Peter Uscinski in his *Finn 7*, (above) a renovated seven metre fishing vessel. Peter developed the engine and boiler for this boat. He said "It's not really a traditional steam boat but it's as close as I can get without having to start from scratch." He is now offering similar engines and boilers for sale. See his display ads in this issue.

AME's under 25s encouragement award

Don't forget to have your project at the AALS convention over the Easter weekend. The entry form and conditions were in the Jan-Feb issue. You don't have to be a member of a club or AALS to enter, the main condition is your age. You will still have to register as a convention delegate to enter the grounds. Your project should be on display for judging over the weekend and you should be present at the prize-giving meeting on Sunday evening.

Recently formed club

Following my request for information in the Nov-Dec issue, Kel Davey sent word about the new model engineering club at Grandchester, Queensland. The club, mainly for those in the Lockyer Valley area, has a portable track and is negotiating a lease on 10 acres of council land close to the Grandchester railway station. The club has a membership of about 24 and meets at 7.30pm on the 3rd Thursday of each month at the Rosewood State High School. The President, Geoff Gillam, can be contacted on (074) 65 5264 for further information.

Wrong number

The correct phone number for information about the formation of the Warringah Model Engineers is (02) 9981 1300 during business hours. Ask for Bob.

CLASSIFIEDS

MICROCRAFT PRESENTS...

- VHS Instructional Videos from the USA (PAL)
  Basic metal lathe operation Vol 1 & 2,
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6" scale Traction Engine For Sale

- Wallis & Stevens, Briggs Boiler, Forced sale, negotiable price, more information contact Bob (097) 33 4019

ALLCHIN TRACTION ENGINE

- Castings & Components for the allchin in 4½" scale (See AME Sept 1995). **Injectors** all sizes to 16 pint. Ph Peter (049) 94 9133

12V DC 20 Amp electric motors. (⅓ HP)

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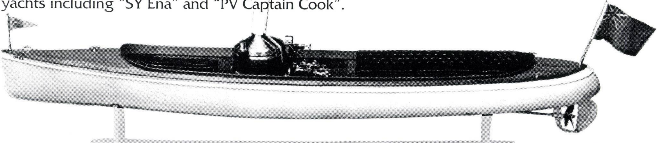

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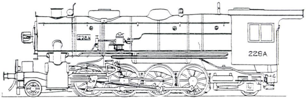

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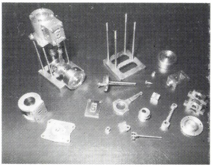

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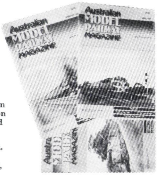

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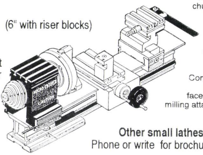

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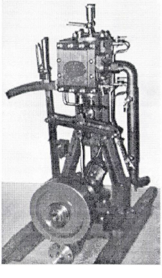

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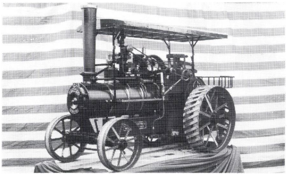

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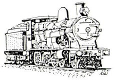

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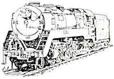

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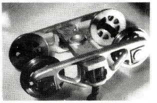

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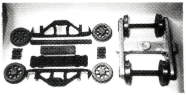

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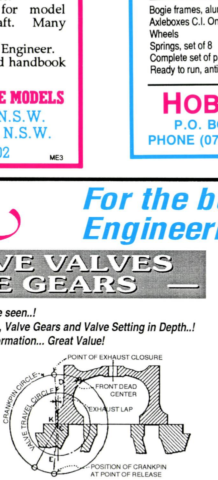
In the preface the authors, Jacob Yoder and George Wharen state, "This book has been prepared to meet a general desire amongst railroad men to acquaint themselves thoroughly with the valves and valve gears applied to the modern locomotive and to master the principles of valve motion as a preparation to valve setting... Valve motion and valve setting have always appeared to many shop men as more or less a mystery. It is the aim of this book to enable all those interested... to acquire a first hand knowledge of it". It succeeds!

- ***Chapter 1*** *(34 pages) you learn about locomotive valves and valve events, and Slide & Piston Valves, including balanced varieties, the universal valve chest etc.*
- ***Chapter 2*** *(60 pages) covers Stephenson Valve Gear. The headings are: Relative Crank-pin and Piston Positions for the Different Valve Events at Full forward Gear. Relative Crank-pin and Piston Positions for the different Valve Events at the Running Cut-off Position. Relation between Motion of Crank-pin and Motion of Piston. errors of the Link Motion. A Study of Valve Gear Parts as they Affect Conditions at the Valve. Effect of Raising and Lowering the Link. The Position of Eccentrics relative to the Crank Pin.*



- ***Chapter 3*** *(75 pages) deals with Walschaert's Valve Gear. The headings are: Introduction. Construction and Development. Description of Parts. Operating Part of the Gear. Relative Crank-pin and Piston Positions for different Valve Events at Full Forward Gear. Relative Crank-pin and Piston Positions for Different Valve Events at Short Cut- off Position. Effect of Raising and Lowering the Link- block. Distortions of the Walschaert Valve Gear. Lay-out of Walschaert Gear. This chapter also covers methods of operating reversing gear.*
- In ***Chapter 4****, having dealt with the two main valve gears, the authors look at the derivatives, namely the Baker Valve Gear (17 pages) the Southern Valve Gear (4 pages) and the Joy, Young, Gooch and Allen gears (6 pages total). Sections in this chapter obviously have to be read in conjunction with the appropriate earlier chapter.*
- ***Chapter 5*** *(10 pages) looks at the Effects of Altering the Valve and its Events, specifically of altering lap & lead, & of shortening the valve travel.*
- ***Chapter 6*** *(38 pages) deals with Valve Setting. As with the whole book, the concern is full size rather than model practice, but this is a chapter full of great information which can be used on models, especially if you use your ingenuity!*
- ***Chapter 7*** *starts with a 5 page summary and then a 14 page Appendix which covers The Steam Engine Indicator and Indicator Diagram. Application of the Diagram, Horse Power of Locomotives, Tractive Force of the Single Expansion Locomotive, Tractive Force of Two Cylinder Compound Locomotives, Tractive Force of Mallet Articulated Compound Locomotives and Classification of Locomotives.*

This book really is wall to wall information! And Messrs Yoder & Wharen really know their stuff! When they collaborated on this book, they were Supervisor and Instructor respectively of Apprentices at the Altoona works of the Pennsylvania Railroad. The "Pennsy" was almost unique in America in that it designed and built its own engines, so it is no accident that the frontispiece photograph in this book is of the first of its legendary "K4" class Pacifics, one of the most successful 4-6-2 designs of all time; 425 built and in top link service from 1914 to 1957. The authors would have known this design well, & played their part in its construction.
Valve gears work in exactly the same way on locomotives of any nationality, but when this book was first available, British designers, notably Churchward, were being influenced by American practice, We like to think that Mr. Churchward, not to mention Mr. Stanier, Mr. Gresley and Mr. Bulleid, all had copies of this book, but if they didn't - you can!
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